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TO ADVERTISERS

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A valued correspondent, who is an engineer of one of the largest British cable-making companies, writes to us: "I suppose, if wireless telegraphy entirely supersedes the submarine telegraph, we will have to bring out a brand new form of golf ball and call it the 'Marconi,' to be made from the gutta-percha of discarded submarine cables; we are not, however, praying for this to come about." It seems safe to predict that golf, perennial as it is and deeply rooted in the affections of the English and Scotch-speaking races, will have disappeared utterly from the face of the earth before it is necessary to reel up the cables in order to turn their cores into golf balls.

SOME NOVEL ELECTROCHEMICAL INDUSTRIES.

The extent to which electrochemical processes are entering the industrial field is surprising, and the directions of their development are sometimes most unexpected. It was not thought, for example, that the electric furnace would emancipate the silkworm, but such seems to be the case. An interesting new process has been brought out in France for the manufacture of artificial silk from the wood pulp, using electrically made carbon bisulphide as a solvent. The results obtained are most interesting and promising, and it is believed that a large outlet for carbon bisulphide will be found in this new industry. The method is extremely simple. The pulp is prepared in the usual way, as in paper-making, and is dissolved in bisulphide. The mixture is then squirted through glass nozzles of exceedingly small dimensions, issuing in fine hair-like threads, which are to all intents and purposes silk as soon as the volatile solvent has evaporated. These threads are then worked in the usual way and spun into threads for the weaving of fabrics of various kinds.

The flavor of the vanilla bean was long regarded as one of the most impossible of all natural flavorings to counterfeit. Yet to-day vanillin, which is the essential aromatic principle of the bean, is manufactured in large quantities by an electrochemical process starting with coal tar products of the anthracene series. Carbon tetrachloride, another product of the electric furnace, promises to take the place of many of the dangerous and inflammable solvents used in the extraction of grease and in a large number of chemical industries. The field for the application of electrochemistry is so vast that it is impossible to give more than a suggestion of the opportunity it opens for development. The examples quoted above, however, show what unexpected results have already followed from the application of electricity to chemical processes.

LONG-DISTANCE TELEPHONY.

Now that we are definitely assured of the successful extension of long-distance telephony by means of recent inventions for improving the quality of transmission lines some very interesting questions are raised as to the practical limitations imposed by other conditions upon a general extension of such means of communication.

The civilized portion of the earth—that is, that portion of it in which much business is done—is situated in a narrow belt encircling the globe in the north temperature latitudes. The principal course of business is like that of empire, from East to West, the principal cities of the world being widely separated from each other in this direction. This separation also carries with it a separation in point of local time due to differences in longitude, so that, for example, the local time in London and in New York is five hours different. Between New York and San Francisco there is a difference of four hours. On this account the business days of the various capitals of the earth do not overlap; for example, the height of business activity in Yokohama taking place at a time when both New York and London are presumably asleep. Of these distinctions of local time the telephone takes no account, and its usefulness is therefore limited since it is obviously impossible for two places so widely different in this important regard to hold immediate conversations with one another upon affairs of daily moment.

The above is only one of the limiting conditions which surround the indefinite extension of long-distance telephony. Another is the difficulty of duplexing telephone circuits, so that for simultaneous conversations separate lines of wire are apparently absolutely necessary. As much of the day's work, in so far as the telephone may be useful to it, is condensed into a few hours, the demands for the use of circuits would necessitate the construc-

tion of many of these between important points, as, for example, it has already required the building of many parallel lines between New York and Chicago. In order to keep these lines of wire busy they are very largely used for telegraph purposes either at night or actually simultaneously with their use as telephone lines. It appears that the sun in making its circuit about the earth will carry with it daily a certain belt of telephone activity in which lines of distances, moderate compared with the dimensions of the earth itself, may operate. The indefinite extension of long-distance lines comparable with telephone lines, etc., is hardly in the present state of the art and of civilization to be considered. Even if systems were built thoroughly, connecting all the places in the United States alone, the time distance between the extremes of the system would greatly militate against its use on business matters, while the compression of such business as was obtained into hours when the business days overlap one another would necessarily require the maintenance of a considerable plant operated at a very low load efficiency.

ELECTRICAL ENTERPRISE IN ITALY.

In the interesting article by Signor Enrico Bignami in the ELECTRICAL REVIEW of April 19 upon the tramways of Leghorn, a curious fact is brought out but not commented upon. It appears that all of the material used in the construction of these tramways was of foreign origin. Nothing but the car-bodies were made in Italy. Wires, cables, boilers, engines and dynamos, rails, trucks and motors were made in Germany and Switzerland.

Of all the countries of Continental Europe, Italy appears to-day to be the most attractive field for electrical exploitation. Abounding in magnificent water powers, with an industrious population, and with admirable advantages for shipping by water from the numerous fine ports on the Mediterranean and Adriatic, it seems to offer an excellent situation for manufacturing enterprises of many kinds. These are being developed to some extent, a considerable business of cotton manufacture being done in the north, while other industries requiring power are springing up about the developing waterfalls. The opportunity to install American electric plants of one sort or another in this country is one that should not be allowed to go by. The Italian ministry of railroads is carefully studying at present the question of using electric traction on the main trunk lines, principally on account of the high price of fuel in Italy. No coal is mined in the peninsula, and freights on such as is delivered from British and German mines are excessive. The whole situation is one that demands the development of the water powers and electrical installations. It might be well for many of our makers of electrical and railway apparatus to give careful attention to the present industrial and material conditions of the Italian peninsula.

NEW METHODS IN ELECTRIC LIGHTING.

The art of electric lighting has extended enormously since the early days of the introduction of the new form of illuminant, but, singularly enough, little change has taken place in the essential methods of its generation. During the last twenty years there have been great and widespread changes made in methods of generating electricity and of distributing it from central stations for illuminating purposes; but the lamp, whether arc or incandescent, has suffered really only one revolutionary change in all this time—that due to the introduction of enclosed arc lamps.

The incandescent lamp of to-day shows practically the same elements as the first lamps that were ever set to burn on a commercial circuit. It consists simply of a filament of carbon, sealed into a glass bulb from which the air is exhausted, and fed with current through leading-in wires of platinum, the only substance that will make an airtight joint with glass. Great improvements have been introduced in methods of manufacture of such lamps resulting in their production in very large quantities at extremely small cost, but essentially the lamp remains much as it was when Edison and Swan brought out the carbon filament lamp for the first time. Its efficiency has for some years remained at or near three watts per candle-power, which, while a considerable improvement over the earlier lamps, yet by no means is an ideal figure.

Since arc lighting is largely restricted to the illumination of streets and large enclosed places on account of the power of the luminous units employed, the incandescent lamp stands as the most notable feature of electric lighting. It is evident that any improvements which may be made in these lamps, or in the production of other electrically operated light-giving apparatus, which can be made in small sizes, will produce very important and even revolutionary changes in the business of electric-lighting supply.

During the past few years a large number of improvements and suggested improvements have been brought out. Among them may be mentioned the Nernst lamp, the osmium lamp, the lamp using titanium carbide filaments, and various kinds of vacuum-tube lamps in which glowing gases are the light-giving media. Of all of these perhaps the Nernst lamp is the most promising at the present time, as it is unquestionably the most developed. This lamp, as every one knows, uses a conducting filament of refractory oxides which, under ordinary temperatures, are not conductors at all, but which, when heated, become conductors of high resistance and glow with a powerful white light. One of the difficulties attending the general introduction of the Nernst lamp has been its manufacture in units small enough to meet the demand for distributed illumination. The tendency even in this country is toward the use of a larger number of lamps of smaller candle-power, rather than toward the increase in the luminous output of the individual lamp employed. For this reason incandescent lamps of eight candle-power are coming more and more largely into general use, while even smaller lamps are employed in great numbers for decorative purposes and sign lighting. The Nernst lamp does not appear to be conveniently adaptable for these small candle-powers, units of about fifty candle-power being apparently the standard small size. The light given by these lamps is magnificent in quality, and their efficiency may be fairly averaged at about two watts per candle-power if we may trust the results

of recent investigations made upon them in England. The cost of these lamps is not excessive and will doubtless be greatly reduced as they are more widely brought into general use.

Lamps of the general style of those invented by Dr. Auer von Welsbach, in which osmium is used as one of the constituents of the filament, show great promise, but so far have not advanced beyond a laboratory stage. In these lamps advantage is taken of the extraordinary radiating power of certain of the rarer oxides and also of their ability to withstand enormous temperatures. The efficiency of the carbon lamp is limited not so much by any peculiarity of the radiating power of carbon as by the fact that this material becomes volatile at very high temperatures. If incandescent lamps could be burned at considerably higher temperatures than they now are their efficiency would be enormously increased, but with this increased efficiency would naturally come a decrease in the lifetime of the lamp, so that the mechanical results would not be satisfactory. The average incandescent lamp may be made to show an efficiency as high as one watt per candle-power for a few minutes by burning it far above voltage.

Similarly, lamps using carbide filaments and other substances of a highly refractory character appear to be very promising, but so far have not been exposed to the test of actual commercial use in large numbers—the only test that will finally determine their value and effectiveness as agencies in electric lighting. Higher efficiency in the carbide lamp is probably not to be had unless the cost of manufacture of the lamps is reduced to such a point that they may be very cheaply renewed and burned upon a schedule contemplating extremely short lives.

Turning now to the arc lamp, very great improvements have been made in the construction of enclosed arcs for operation both on direct and alternating currents. In this type doubtless improvements in carbon will have more to do with benefiting the output efficiency and lifetime of such lamps than any further changes in their mechanical or electrical construction. It is evident from the improvement that has been made constantly and steadily in carbon manufacture for many years that we have not yet reached finality in this direction, and that we may hope to see improved processes bringing out grades of carbon greatly superior even to the best that are now in use. In this connection, the interesting Bremer lamp, which is an open-arc lamp using chemically prepared electrodes, seems to show some promise of improvement especially as regards the quality of the light given.

Vacuum tubes can scarcely be said to have yet entered the field of electrical illumination, but there is hardly any other direction of electrical engineering that seems to hold out more promise or to be more interesting and potential than a study of the curious luminous phenomena exhibited by highly exhausted tubes. The classical experiment of Mr. Cooper-Hewitt with a variety of lamp which is not, strictly speaking, a vacuum lamp at all, but a mercury vapor arc lamp, has shown at least the possibility of getting a large amount of light from such instruments with very high efficiency; but unfortunately the light is of an unpleasant color which will need to be remedied before such lamps come into general use for illumination.

The whole subject of electric lighting depends entirely upon the translating device or lamp. There is little or no hope for improvement in the dynamo or in the method of transmitting power to the lamp, since both of these have reached a point of efficiency such that little more is left to be done to make them perfect. It is, then, to the lamp that we must look for the great improvements in electric lighting that may be hoped for in the more or less distant future. What form these improvements will take can hardly even be surmised at present, but we are all aware there is plenty of room for them, while no real physical reason so far as known stands in the way of their successful introduction.

The annual report of the General Electric Company, just issued, shows that the year has been one of unprecedented prosperity. The work of this company enters into nearly every branch of the electrical industry, and its highly lucrative business may be taken as an indication of the phenomenal demand for the products of the electrical factory.

THE GIFT OF CECIL RHODES.

The late Cecil Rhodes was the first Englishman to make a very large donation of money for educational purposes. The millionaires of this country have been in the habit of founding universities and of making foundations for the encouragement of study for many years, but the munificent provisions of Mr. Rhodes's will are about the first of their kind in the older country. The effect that they may have upon American engineering and scientific students is a subject of great and particular interest.

It is provided that a large number of students from this country shall be sent annually to the university at Oxford, where an extremely liberal provision is made for their maintenance and tuition. The object of the donor was to secure a better international understanding by means of bringing the brightest young men that could be selected from this country, Germany and the British colonies to the university at Oxford, where they might be imbued with some of the ancient and respectable traditions of that institution. The question that may immediately be asked is whether or not it will be of any particular benefit to American students of science and engineering, especially to spend the time requisite in completing their education at Oxford.

Of all schools none is more closely allied to mediævalism than is the group of colleges that go to constitute the University of Oxford. Around them lingers a tradition that, interesting and potential as it is, is largely out of tune with the spirit of to-day, and we may say with that of the future, as nearly as we are able to foresee the future. Oxford represents the crystallized conservatism of the British character; its scholastic calm is widely at variance with the strenuous leanings of twentieth-century activity.

In this issue of the ELECTRICAL REVIEW is presented a critical study of the rapid-transit situation in Boston from the able pen of Dr. Louis Bell. This contribution will be read with interest, as the problem of transportation is a serious one in every growing city. That the usual practice in planning transportation facilities is to make greatly inadequate provision for future expansion and development is unfortunately only too true. Dr. Bell discusses the character of railway construction of the future as well as mistakes of the past, and his article will receive the consideration that the high standing and experience of its author abundantly deserve.

THE BOSTON RAPID TRANSIT SITUATION.

BY LOUIS BELL.

Our present situation here in the Hub is a beautiful example of the foolishness of doing things by halves. Mayor Collins summed it up the other day in the words: "We do not make provision for anything beyond the ken of a short-sighted generation." Consequently there are now up for consideration several more or less ineffectual and futile suggestions for a subway under Washington street. Rapid transit for a large city is anywhere and always a formidable problem, but in some respects Boston is exceptionally difficult. In New York the distribution of population is such that the general plan of a great longitudinal trunk line can be followed with good prospect of success.

Boston presents altogether different conditions. There are three general lines of suburban travel running north, west and south from the centre of the city. The western division may, in fact, be subdivided into two sections, one trending northward to Cambridge and beyond, the other slightly southward to Brookline and the Newtons. Any comprehensive scheme of rapid transit must take these four lines into consideration, together with suitable provisions for transferring from one to another.

Now our present arrangement consists of short elevated lines running northward and southward only, linked into a continuous system *via* the subway, *plus* a much needed and very useful short belt line connecting the North and South Union stations. The main elevated system runs trains between Dudley street on the south and Sullivan square on the north, but the actual through traffic between these termini is inconsiderable, most of the travel being for obvious reasons to and from points about midway the line. The Park street station is practically the central point of the whole Boston system, elevated and surface, Scollay square being the only other city station bearing any considerable traffic. At present the system fails of efficiency largely by reason of the totally inadequate station-room at Park street. Mayor Collins says that this station has not over forty per cent of the working capacity it should have, and from my own observation this would seem about a fair estimate.

If a rapid-transit system is so designed that it discharges and takes on most of its passengers at a single point it is extremely hard to provide too much room at that point. As a matter of fact, long before the subway was completed it was evident that there would be trouble at Park street, and that the addition of elevated cars to the tangle would greatly aggravate it. This is a fact not generally realized by outsiders and on which stress should be laid for the benefit of other cities struggling with similar problems. To a casual observer it seems a very neat and clever scheme to work overhead in the outlying districts and then pass underground in the central portion of the city where elevated tracks might not be welcomed. Of the welcome actually extended to the elevated tracks I will speak later, but the main plan necessarily met trouble on account of inadequate station-room. This was actually foreseen, and an audacious attempt was made to raise a cry of congestion and seize Tremont street again for the surface cars, a proposition which the people promptly cast into outer darkness. Congestion indeed there was, but it arose from the original blunder of trying to serve the city from a single distributing point, and crowding into it an elevated system that is at best a dubious benefit. Congestion is the shibboleth of lobbyists hankering after more franchises.

The putative glories of our present rapid-transit system were set forth very naively in a recent number of *Harper's Weekly*. As an article in so reputable a journal carries much ostensible weight it may be well here to point out for the benefit of the public certain things which should have been there noted for the sake of the whole truth.

For instance, it is an item of some importance in a system lauded for its completeness that the trunk line into which the traffic has been forced crosses a drawbridge over navigable waters of the United States. Sooner or later this circumstance will lead to more than casual trouble, and a similar blunder should be avoided elsewhere. If traffic is to be withdrawn from its natural and convenient channels and squeezed into a single line, that line should be clear twenty-four hours per day. Another statement, which, unexplained, would greviously mislead, is that Boston has universal free transfers and that the Boston Elevated Railway Company has provided these so generously that its receipts show an average of only two and one-half cents per fare. Nothing could be further from the actual facts when they are understood. So far from having universal free transfers Boston has an incomplete and limited system except where the Elevated compels passengers to change cars for its own profit and convenience.

It is perfectly true that passengers can ride for a single fare from the northern to the southern suburbs of the city, but they had this privilege when the Elevated was only a nightmare. Under the excellent West End régime it was possible for a single fare to ride even from Arlington Heights to Neponset, a distance of nearly a dozen miles. The importance of electric roads in the development of Boston's suburbs has been very great and there have been many long free transfer routes in the system, most of them, however, utilized by a very moderate number of passengers.

Under the present arrangements one can ride from the northern to the southern suburbs for one fare by changing cars twice, but there is no free transfer between the elevated road and the western suburbs save in a single direction. One may freely go from, let us say, Newton to Malden *via* the subway, but he can not ride from Newton to the Pleasant street entrance of the subway or any point of the elevated road south of Boylston street without paying two fares. And, incidentally, if he wishes to do this he must climb out of the subway, walk a hundred feet or more and then go down cellar again through another entrance. There used to be a very convenient subway passage at the Boylston street station connecting the several tracks, but this is now walled off and the passengers can take their climbing exercise.

Of the lavish transfers which, according to the *Harper's Weekly* article, are granted Bostonians by their benign monopoly the vast majority are transfers from the suppressed through lines to the elevated road, into which their former traffic is now shoveled. For the rest the transfer system is strongly reminiscent of the free list of a high-protectionist tariff bill—rich in things which nobody wants. The really useful part of the transfer system, that giving easy access to the railway stations, had to come as soon as easy lines of traffic could be established. How valuable would free transfers from crosstown lines to the Manhattan Elevated be to New Yorkers if the price paid were the practical suppression of all other surface lines?

The returns of the last year in Boston show that nearly one passenger in four was transferred, and most of the terminal transfers to the elevated line being "bodily transfers," it would be extremely interesting to know what proportion of this

percentage represents extension of free transference for public convenience.

Be all this as it may, the real problem which confronts Boston is what to do next. According to the allegations of the Elevated company, the increase of annual traffic since 1898 amounts to nearly 70,000,000 passengers carried. In spite, therefore, of the most strenuous efforts to pull off the surface cars and force traffic upon the elevated road proper, the programme has been upset by sheer physical incapacity. The elevated trains are run on short headway, thanks to an excellent block system, and the passengers are packed into them like hay under a baling-press, but still the overflow howls for cars.

As a result several bills are now under discussion providing for the construction of a subway under Washington street. They differ considerably in detail, some proposing deep tunnels and some shallow ones, some providing for construction by the city and others turning this over to the Elevated company; but they all demand immediate action and mean business. But the thing really needed is not so much the building of a tunnel under a particular street as the organization of a coherent rapid-transit system with reference to the demands of the future. It is absurd to plan without a broad view of the requirements.

Considering the geographical situation and the distribution of the population, three conditions must be fulfilled by any rapid-transit system which will remain worthy the name even for a few decades.

First—There must be easy access to the centre of the city from at least four directions.

Second—There must be good intercommunication between railway stations.

Third—There must be ample facilities for passage from any radial direction to any other and to any railway station.

Obviously all this should be accomplished in the most direct and least inconvenient manner possible. With modifications due to the number of fundamental traffic points, these principles will hold for any city whatever.

Now the present Boston system in its existing stage of evolution approximately fulfills only the second of these conditions and that somewhat imperfectly. Its weak point in intercommunication between stations is that no provision is made for transport of luggage. It is absurd at this day to whisk passengers across the city on a fast elevated line and let their luggage take its chances in the crowded streets. It would have been eminently wise to give the Elevated the right to handle luggage, mail and express matter on its Atlantic avenue line and to have insisted on the utilization of that right in conjunction with the railroads connected. Such traffic could be made to pay a considerable revenue and would be a great public convenience.

The first condition is at present very imperfectly met, except within certain limited areas. In the two westerly directions the surface facilities are or could readily be made reasonably good, but the cars run into an overcrowded terminus. North and south, subject to the same objection, the facilities near the termini of the elevated sections of track are good, but are poor outside the termini on account of a forced change of cars, and poor inside by reason of the suppression of many of the surface lines.

The third condition is only met in a very limited way. The stations are reached with a fair degree of ease, except for changing cars in a crowd, but the radial lines do not interlink well as has already been indicated.

Whatever may be done in the way of additional subway its relation to the rest of the system must not for a moment be forgotten. If by the building of a tunnel under Washington street a new route were provided for the elevated cars the way would be cleared for the westerly traffic to expand in the present subway, but provision would still have to be made for contact between this and the north and south lines, and for connections between both and the circuit between the stations.

In the writer's opinion the main thing to be looked out for is the prevention of such congestion at a single station as has afflicted Park street. When all the traffic of a large city converges at a single point, which is both terminus and transfer station, there can be but one result and that a bad one, in spite of any extension of area. If the separate radii of travel can have separate termini, interconnected for transfer purposes only, traffic during the rush hours can be taken care of much more easily than in a single terminal station.

The relation of the elevated structure to the future of rapid transit is a rather dubious one. In New York there is a well developed and well operated surface system in open competition with the elevated lines, serving the same territory, and the mass of traffic being along one direction only, the elevated lines are extremely useful, particularly for the longer runs. Here in Boston the lines of traffic spread out fanwise and it is very doubtful whether any system of trunk lines can be of material use so long as they involve a change of cars. According to a recent authoritative statement of the Elevated company the present running time between the Dudley street and Sullivan square termini is twenty-two minutes as against the old forty-five minutes on the surface cars. The saving in time due to the institution of the elevated service is then only ten to twelve minutes, so far as the ordinary passenger is concerned, and out of this must be taken the time lost in waiting for connections and the great annoyance of a change in cars. The practical gain in time is therefore trivial, particularly in cases where two changes of cars have to be made, and I am more than half inclined to take sides with Judge Dewey, who recently expressed the opinion that the elevated tracks could have been much better utilized by using them merely as clear routes for surface cars. An intelligent extension of the multiple-unit system could certainly be made to give, without involving a change of cars, far more convenient suburban service than we now have.

Of course, if the elevated tracks were greatly extended the saving in time might become material, but there is not now evident any direction in which they could be so extended and still win a reasonably heavy traffic unless by the present process of driving people upon the elevated lines by cutting off their surface facilities.

In response to demands for more surface cars in the Charlestown district the Elevated company claims to have counted noses and found scant traffic even in the cars now run. This is a natural result of making the surface facilities thoroughly bad. When enough cars are taken off to make using them uncertain and inconvenient, passengers will take to almost any conveyance that is at hand. If the surface schedule of two years ago were resumed in its entirety, the elevated system proper would do well if it cleared enough to keep the cars in axle grease.

The unsatisfactory performance of the elevated section of the system has an important bearing on the nature of any future developments. Any programme which would encourage the building of more overhead structure is certainly reprehensible unless that structure is very differently operated from the present one. Aside from the general objection to the way in which traffic is being driven upon that little desired disturber of the peace, it is without doubt the noisiest pest of the kind ever erected. A variety of causes conspire to produce this result, and in-

cidentally to scatter along the line an exceptionally large amount of steel dust. Some scores of suits for property rendered untenable and eyesight injured are already pending and there will be more before there are less.

Therefore, whatever additional subways are built should be so directed as, if possible, to relieve the city of this nuisance, and to give continuous lines of travel, without change of cars, from the city into the suburbs. For the more distant points the city is well provided with railway facilities which are not yet worked up to anything like their full value and which should be encouraged. With the railway lines electrically equipped and operated as adjuncts to surface lines passing into the necessary subways Boston would be assured of good rapid transit facilities for many years to come. The East Boston tunnel, although itself a product of shady politics and in no wise justified by the importance of that district of the city, is a step in the right direction.

Whatever the engineering details of the proposed new subways may be they should assuredly be built like those now in existence—by the city. Doubtless such a procedure would imply a huge amount of crooked dealing, but on the whole this would be on a higher moral plane than the stock-watering that generally follows putting such a temptation in the hands of a corporation.

In the present case the Elevated company disclaims any desire to undertake the task at its own expense, alleging that in its altruistic efforts in behalf of the public it has already incurred so large expense that plain duty to the hungry stockholders forbids costly extensions. It is really a pleasure to note such virtue, but might it not be well to retrench by cutting down the "reptile fund" instead of pulling off more surface cars?

In any event, the interests of the city certainly demand that the Elevated should be relieved of the burden of construction and that every foot of permanent way for the evolution of Boston's rapid-transit system should remain forever the inalienable property of the people. And, moreover, any additional subway should be so built that whatever may be its temporary uses it may at any future time be effectively operated in connection with surface as well as with elevated cars.

Under the present arrangement for the suppression of competition the elevated and surface systems are united until 1917 and the public, for its own safety, must see to it that there is no physical obstacles to their perpetual separation at that date. Most of the additional subway schemes thus far proposed have taken no thought for this and supinely assume that there will be no change when the present arrangement expires by limitation. To tell the unpleasant truth, more than one such scheme has shown the cloven hoof by providing for a lease to the Elevated, breaking joints, as it were, with the present leases so as to forestall effectively any chance for a radical change. Any device which will tie the hands of the people in 1917 is against public policy and in the interest of the present monopoly. Monopoly is assuredly not in itself evil and is sometimes wisely and justly administered, but it may put a sharp sword in the hands of rapacious and unscrupulous men and its edge the public may too often feel.

The status of public service corporations will be an important factor in future civics, and however safe such corporations may now feel behind the armor of judicial support there may be a day of wrath in which their accounts with the people will be reckoned up with an unsparing rectitude. There is a strong and growing belief that public franchises belong of inherent right to the people for all time and that no power permanently to alienate them lies within the rightful function of any body of public servants; that the thoughtless or venal actions of yesterday may not rightfully sell the birthright of to-morrow, that while an equity in such public property may be acquired by the utilization of a temporary grant it can not exceed in value the actual private investment in this public domain.

If these principles are politically established, as the present outlook indicates may happen ere long, the people may choose to assume their ancient rights and take their own again. It therefore behooves even reckless and corruptible politicians to see to it that they prepare for the wrath to come. The fewer winds they sow the fewer whirlwinds in the harvest. At the rate things are now going, the people will soon be in ill temper to brook quibbles and will not be long disposed to shelter nefarious inequity behind the obligation of a contract. It is then doubly important for those who are trying to safeguard civic rights to see to it that all concessions from the public are simple, uncomplicated by underlying grants and for terms so brief that the hands of their successors will not be tied in working for the public good.

ELECTRIC FURNACES.*

BY BERTRAM BLOUNT.

The function of an electric furnace is to produce a temperature of a degree, or in a place, unattainable by other means.

The first proposition is proved by the fact that such substances as silicon carbide or carbon boride can not be prepared by any other method than the use of the electric furnace, because they need for their information a temperature higher than 2,000 degrees centigrade; the second is illustrated by the incandescence of the filament of a common glow lamp, inaccessible to ordinary methods of heating. The rough limit of temperature set (2,000 degrees centigrade) depends on the point of dissociation of all compounds of carbon and hydrogen with oxygen.

We have no evidence that quartz is volatile at any temperature reached in industrial non-electrical furnaces, and these at their best give a temperature not greatly above the fusing point of platinum (1,775° C. = 3,227° F.). We may conclude with fair approximation to accuracy that the highest temperature attainable from fuel is at or about 2,000 degrees centigrade.

But by the use of electrical energy the whole output of a large prime mover can be expended in a small box so well isolated that its loss of heat is insignificant. The natural and inevitable result is the production of an exceedingly high temperature. The advantages thus gained have been turned to excellent account industrially and in chemical research.

No dissertation on the subject of electrical furnaces would be in any sense adequate without due reference to the work of Moissan. This bold and original chemist has done more to put our knowledge of reactions at high temperatures on a sound footing than any of his predecessors or contemporaries. Moissan has succeeded in fusing, volatilizing and crystallizing such refractory materials as lime, magnesia, platinum, silica, zirconia and carbon. He has studied the allotropy of carbon, and incidentally produced the diamond; he has prepared a whole series of novel carbides, borides and silicides, and on the basis of his experiments he has advanced a new and sagacious theory of the origin of petroleum.

Looking through Moissan's work I have picked out those substances and reactions which seem to me most likely to become of industrial importance.

Calcium carbide and silicon carbide

*Paper read March 4, 1902, before the Institution of Electrical Engineers (Manchester Section).

(carborundum) are already commercial products.

Alumina is one of those oxides which fuse and volatilize in the electric furnace; on cooling it crystallizes as corundum, or, if a trace of chromium is present, as ruby. The case of carbon and its conversion to the octahedral form (the diamond) is too trite for repetition, but the inventor who succeeds in preparing masses of this very hard substance in a determined shape, and not brittle like the natural crystals, is certain of reward.

A substance which may sooner be made in quantity and put into use is fused silica. Professor Boys first demonstrated the great possibilities of this material. Mr. Shenstone has shown that quartz fused before the oxyhydrogen blowpipe is in all ways superior to glass as a transparent and refractory material for the construction of apparatus. At present tanks of glass of fair size can be cast in spite of the brittleness due to its internal tensions. With quartz fused by the ton, and similarly cast, it should be possible to prepare great vessels indifferent to sudden changes of temperature and practically permanent under the most severe conditions. Investigations in this direction are being prosecuted by Mr. R. S. Hutton, who has achieved some remarkable results.*

Proceeding with our catalogue of useful substances, graphite may be mentioned. Natural graphite is a gritty and inferior material. A hard-cutting siliceous ash will make graphite useless as a lubricant, and the merit of some of the brands esteemed for this purpose no doubt rests on their mineral contents chancing to be soft or even lubricative. But with artificial graphite this good property could be procured by design instead of accident. All forms of carbon, crystalline or amorphous, are converted in graphite at a temperature sufficiently high. It follows that artificial graphite may be manufactured by heating directly any kind of carbon sensibly free from mineral matter. A method, differing from this in principle, consists in dissolving carbon in a fused metal until it is saturated at a high temperature; on cooling, a portion of the carbon is thrown out of solution as graphite.

Crystallization from a supersaturated solution of carbon in a metal, or its carbide, may be supplemented by providing the metal with some other substance with which to unite, and thus displacing the carbon. All engineers know that gray pig run down in a cupola becomes harder, but not every one may be aware that this is due to selective oxidation which tends to eliminate silicon, and thus to allow the recombination of the iron with carbon previously displaced by that silicon as graphite. Conversely, if silicon is added to iron saturated with carbon a portion of the carbon will be displaced and appear as graphite. There are, therefore, three methods for the manufacture of graphite by means of the electric furnace.

Acheson in his U. S. A. Patent No. 568,323 claims broadly the manufacture of graphite by the decomposition of a carbide, a claim which clearly is untenable because the decomposition of a carbide and the production of graphite thereby have been known for many years. Whether Acheson's methods are followed

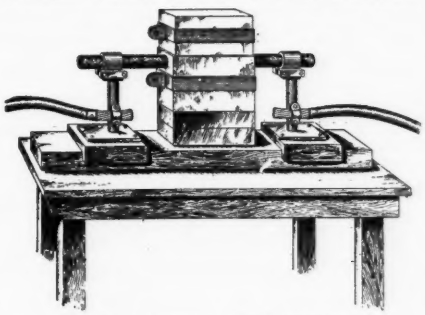


FIG. 1.—MOISSAN ARC FURNACE.

or not, it is probable enough that artificial graphite will eventually displace the natural material. Graphitized carbons are also manufactured by heating ordinary carbons electrically to a temperature high enough to convert them partially into graphite.

A number of refractory metals, such as chromium, tungsten and molybdenum, can be readily prepared in the electric furnace; some at least—*e. g.*, chromium—can be prepared more rapidly and in greater purity by a purely chemical method, *viz.*, by the reduction of their oxides by aluminum. But although the electric furnace is thus put momentarily in the background, an electrical method is still a necessity, for the only process for making aluminum which is at present feasible is electrolytic. When it is generally realized that aluminum may be regarded as a powerful, compact and non-volatile fuel, that metal will be manufactured, perhaps somewhat impure, but cheaply and in quantity for a variety of purposes quite distinct from those which it serves as a metal useful in the arts.

The last substance which I shall mention is carbon boride, CB_6. The chief industrial merit of this substance is its extreme hardness which approaches that of the diamond.

TYPES OF ELECTRIC FURNACES.

There are two types of electric furnace, the arc and the resistance furnace. Both are used in industry. The simplest effective form of arc furnace is that devised by Moissan, shown in the accompanying figure (Fig. 1). It consists of two blocks of chalk carefully dried and carved out so as to form a cavity in which a carbon crucible can be placed. Massive carbon electrodes pass into this cavity, and the arc formed between them plays over the hearth, heating the material to be treated in the manner of a common reverberatory furnace. The chief merits of the furnace are its extreme simplicity and the refractoriness and low conductivity of its materials. In the form shown, this furnace is necessarily discontinuous, but the complete inclusion and surrounding of its charge give it much advantage. Where contact of the charge with the electrodes is not harmful, it may be possible to make this furnace continuous. There is no reason why a charging and a tapping hole should not be provided, in which case the run might be sustained. The natural use of a furnace of this type is for the production, at a high temperature, of metals, alloys, carbides and similar fluid bodies which are too conductive to allow of easy heating in a resistance furnace. The application of the high heat of combination of aluminum to the reduction and fusion of refractory metals

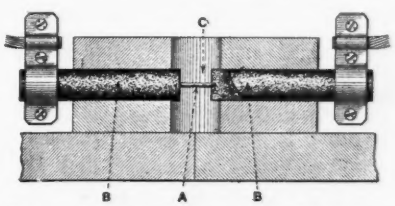


FIG. 2.—BORCHERS RESISTANCE FURNACE.

limits the utility of this class of furnace, and at the present moment it is used only in one industry with which I am acquainted, and then in a modified form. I refer, of course, to the manufacture of CaC_2.

A typical resistance furnace is that devised by Borchers, and shown in Fig. 2. It consists of a slender carbon rod, A, supported between two stout carbon rods, BB. The small rod bridges the cavity, C, which can be filled with the material to be treated. On passing a sufficient current the rod is raised to a high temperature, and the charge is heated from its very centre. This class of furnace is evidently generally adaptable, provided that the product of the action of the high temperature, *e. g.*, a metal, does not collect and form a good conducting connection

*Mr. Hutton's experiments have lately been described in a paper read before the Manchester Literary and Philosophical Society.

between the large carbon rods. The type is represented by the furnace employed for the manufacture of carborundum.

These two types of furnace, *viz.*, that in which there is a definite arc, and that in which the heating is effected through a core of high resistance, or the charge itself, will be found to represent in one class or another all the industrial furnaces about to be described.

In his paper, about twenty years ago, before "The Society of Telegraph Engineers," Siemens laid down with clarity and precision those principles on which the successful operation of the arc furnace depends. He proceeds successfully to experiment, and states: "In working with the modified medium-sized dynamo

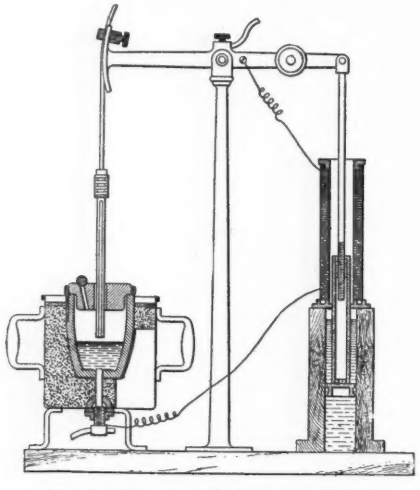


Fig. 3.—Siemens Electric Furnace.

machine, capable of producing thirty-six webers of current with an expenditure of four horse-power, and which, if used for illuminating purposes, produces a light equal to 6,000 candles, I find that a crucible of about twenty centimetres in depth immersed in a non-conductive material is raised up to a white heat in less than a quarter of an hour, and the fusion of one kilogramme of steel is effected within, say, another quarter of an hour, successive fusions being made in somewhat diminishing intervals of time." He finds that there is an efficiency of thirty-three per cent, by no means a bad return in so small an apparatus. The electric furnace has, he says, the following advantages in its favor: (1) "That the degree of temperature attainable is theoretically unlimited; (2) that fusion is effected in a perfectly neutral atmosphere; (3) that the operation can be carried on in a laboratory without much preparation, and under the eye of the operator; (4) that the limit of heat practically obtainable with the use of ordinary refractory materials is very high, because in the electric furnace the fusing material is at a higher temperature than the crucible, whereas in ordinary fusion the temperature of the crucible exceeds that of the material fused within it." The Siemens electric furnace had the electrodes arranged vertically as shown in Fig. 3.

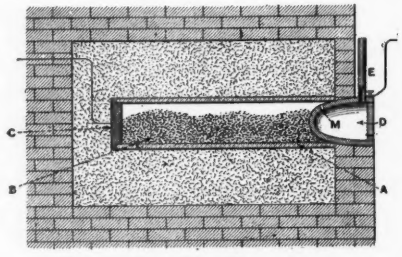


Fig. 4.—For Zinc Reduction.

As the charge fused, the arc played between it and the upper electrode. The regulation of the position of the upper electrode was effected by a solenoid and dash-pot similar to the arrangement then in use for arc lamps. A later pattern had the electrodes inserted through the walls of the crucible horizontally. The Siemens furnace does not seem to have received the application which its inventor had reason to expect, *viz.*, the industrial fusion of refractory metals, and it does not appear to have been adapted to the reduction of their oxides and the preparation in this manner of refractory metals such as chromium and tungsten in reguline masses. But little more of importance was done in the development and application of the electric furnace until 1884, when the Cowles furnace was invented. This was a resistance furnace,

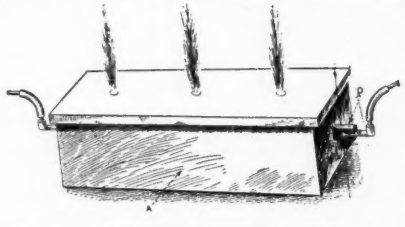


Fig. 5.—Cowles Furnace (Perspective).

but instead of there being a continuous rod of carbon bridging the space between two massive conductors, also of carbon, as in the typical resistance furnace due to Borchers, and illustrated above, the Cowles furnace used the charge itself as the resistance material. How this was arranged is shown in the accompanying figures. (Figs. 4, 5, 6 and 7.)

The first figure is interesting because it represents an apparatus adapted for the process of zinc reduction and distillation by electrical means—a process which, although certainly rational and probably practicable, has, as far as I know, never been established on a manufacturing footing. The fire-clay retort, A, is protected from loss of heat by being embedded in refractory non-conducting material, B. The charge of zinc oxide and carbon serves as the resistance material to be heated by the passage of an adequate current between the carbon plate, C, forming the end of the retort and the graphite crucible, D, serving both as a closing plug and a condensing chamber for the zinc distilling from the retort through the side hole, M. Gases—*e. g.*, carbon monoxide—generated during the reduction of the zinc oxide escape through the pipe, E. No account has come to my notice of the reason which prevented this furnace being brought into use. It is probable that it failed because of the difficulty of so preparing the charge that it should consist on one hand of a mixture of zinc oxide and carbon intimately mixed for reduction, and on the other should constitute a granular semi-conductive mass suitable as a resistance material, and capable of being uniformly heated by the passage of the

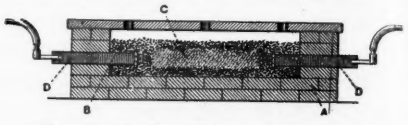


Fig. 6.—Cowles Furnace (Section).

current. Further, it is evident that as the charge was worked off, its composition and physical structure would be progressively altered by the distillation of the reduced zinc, and the removal of an equivalent of carbon as carbon monoxide and its electrical resistance would therefore be continually varying; a large excess of carbon would in any case be necessary, for otherwise toward the end of the run one could hardly hope to have a continuous uniform semi-conductive bridge between the two carbon ends of the retort. Such working difficulties may well have caused the abandonment of the process and have delayed the realization of a promising application of the electric furnace of the resistance type. The fifth and sixth figures represent in perspective and in section the familiar form of what is commonly known as the Cowles furnace. A modification less well known is shown in Fig. 7. The essentials of both are the provision of a core of resistance material consisting of a mixture of ore with carbon to serve the double purpose of conduction and reduction, and the surrounding of this core with a material highly refractory, and at the same time a bad conductor of heat and

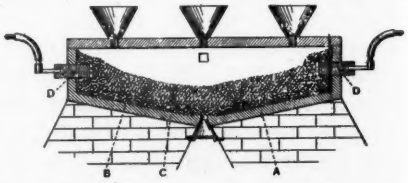


Fig. 7.—A Modification of the Cowles Furnace.

electricity. Such a material is granular charcoal. In the drawings shown similar parts are indicated by the same letters. A is a fire-brick casing, B is the protecting layer of granular charcoal and C is the semi-conducting charge. The carbon conductors, by which the current is led into the furnace, are shown at DD.

(To be continued.)

Electric Elevators, Electric Hoists and Telpherage—I.

Papers and Discussion at the One Hundred and Sixty-Fourth Meeting of the American Institute of Electrical Engineers.

THE one hundred and sixty-fourth meeting of the American Institute of Electrical Engineers was held Friday evening, April 25, at No. 12 West Thirty-first street, New York city. A similar meeting was held at the Monadnock Building, Chicago. The general subject of the meeting was "Electric Elevators, Electric Hoists and Telpherage," and two papers were presented, "Power Consumption of Electric Elevators with Alternating and Direct-Current Motors," by George F. Sever, of New York, and "Telpherage," by Charles M. Clark, of New York. Mr. Sever in presenting his paper touched on the important points considered and invited discussion with a view of stimulating a productive interest in this feature of electrical application of motive power. Mr. Clark could not be present, and his paper was read in abstract by Mr. Douglas Burnett.

In introducing the subject for the evening President Steinmetz called attention to the various conditions which regulated motor service in these lines of application, and likened elevator service to that of railway operation in that it was intermittent, but with the difference in elevator service that the form of propulsion was vertical as compared with horizontal in the case of the electric railway. With the electric railway there was the high-starting torque and the increased work necessary in climbing grades, but the car normally, that is, standing still, was at a condition of rest and the problem of running away was one of secondary importance. With the elevator, on the other hand, the form of propulsion was vertical. The elevator motor had to have the high-starting torque necessary to produce rapid acceleration, and another condition imposed upon it was that at no time was the load during a trip at rest; that is, the motor had to work against the friction of the moving parts, lifting the elevator, and even in standing still had to perform work against gravity.

He compared the electric power for elevator service with other forms of motive power and suggested that while the hydraulic form of elevator had an advantage in smooth running, it was an apparatus of decidedly low efficiency; and above all, the one feature which made electric motive power preeminently the better for this class of work was that the power consumption was in proportion to the load only, this condition existing with an electrically driven form of apparatus alone.

With the question of telpherage, Mr. Steinmetz remarked that in this case the propulsion was in a horizontal direction with the load suspended beneath the rail or cableway. He called attention to the fact that there were a great number of motors in operation for elevator lifting devices and in telpherage work. This amounts in New York city alone to a very great horse-power, and he thought that it was a question which was a serious one to central station managers. He would like to have seen or heard a more complete trial and results given of the work of alternating-current motors.

The reading of the papers occupied but a very small time of the meeting, but the discussion was prolonged for several hours. Messrs. Abbott, Torchio, Mershon, Ihlder and others debated on capacity, maintenance, relative qualities of the alternating and direct-current systems for elevator work, and the hardiness of motors under the conditions in which they were placed in most apartment-house installations. The discussion was confined wholly to matters in connection with elevator service, and in point of attendance and interest the meeting was a very successful one.

The next meeting will be on Tuesday, May 20. The annual business meeting and election will be held at this time.

POWER CONSUMPTION OF ELEVATORS OPERATED BY ALTERNATING AND DIRECT-CURRENT MOTORS.

BY GEORGE F. SEVER.

The record of electrically operated elevators in New York city shows that there are approximately 3,000 operated by direct-current motors, and 300 operated by alternating-current motors. One reason why this disproportion exists is that the direct-current motor has been available for a longer period than the alternating. Another is the uncertainty as to the amount of power necessary for each. If the consumption of power for one type of elevators makes its operation more expensive than another, but the use of this type overbalances any disadvantages possessed by one which consumes less power, then it will be the more desirable machine. Certainty of operation due to simple controlling devices, great overload capacity permitting the elevator to be operated under unusual conditions, are two important requirements. If the alternating-current motor can not fulfill these requirements economically, immediately we find another explanation for its small application as compared with the direct-current motor. When the location of the apartment-house or office building is such that it is not possible to secure direct current for the operation of electric elevators, it is, of course, necessary to use the alternating current. In some sections of the city it is at present impossible to secure a direct-current supply, and the users of elevators have been of necessity compelled to install the alternating-current system.

It was brought to the writer's attention that there was considerable difference of opinion as to the consumption of power for the two different types of electric elevators, one using alternating and the other direct current. In the hope of bringing forth further facts concerning this matter, investigations were undertaken to determine the power consumption in the two different lines. The work has been successfully conducted by Messrs. Rosenblatt, Daniels and Haviland, senior students in the electrical engineering department of Columbia University, by making numerous tests on elevators of the different types providing similar service. Twenty such tests have been made and the results of the most characteristic installations are given in the appended table. The first five relate to direct-current and the subsequent tests to alternating-current motors.

It will be noticed that these investigations have been made in widely different sections of the city, with the alternating-current installations in that part where direct current is not available. The types of control for the direct-current motors are known as magnet control, although No. 3 is regulated by hand. Four of the

alternating-current motors have no method of control, the current being thrown directly on the motor by a switch. No. 10 has what is known as a two-voltage control, using two transformers, one giving sixty volts for starting and the other 175 volts for the running voltage. No. 11 has a rheostat control. This is arranged is such a way that resistances are altered in the rotor of the alternating-current motor giving four steps from standstill to full speed.

One very interesting point in connection with the alternating-current motors is the test No. 11, with the controlling system using resistances in the motor, the inrush currents are maintained at a value comparable with those used in the direct-current motors.

In test No. 1 of a direct-current elevator with twenty-three people carried up, the current at starting is 199 amperes with running current of 150. In tests Nos. 6 and 8, with only two or three people carried up and down, the current varies from 170 to 193. In comparing the kilowatts for starting in these two cases, we find 19.8 for the direct-current elevator and

Curve sheet No. 1 shows the average energy for all elevators through a rise of fifty feet carrying two passengers, the energy being expressed in kilowatt-seconds. Curve sheet No. 2 shows similar values for the descent of the elevator. Curve A on curve sheet No. 1 shows the average of the alternating current and curve B that for the direct-current tests. The areas of these two curves are to each other as 1.509 is to 1. This shows a percentage against the alternating-current elevators of thirty-three per cent. Referring to curve sheet No. 2, and com-

Test No.	Location.	Date installed	Type of control.	Rise in feet.	Velocity. Designed	Velocity. Actual. Down	Velocity. Actual. Up	Duty in pounds.	Overweight in lbs.	Motor capacity and type	Load.	Volts of line.	Current for starting.	Current for running.	Power in k. w. for starting.	Power in k. w. for running.	Power factor starting.	Power factor running.
1	Horace Mann School 120th St., N. Y.	June 29, 1901.	Magnet control, style P. A.	70′–1″	200′ per minute.	200′	200′	2500	900	110 volts, 175 amperes, 800 r.p.m.	2 people up. 2 " down. 3 " up. 3 " down. 10 " up. 10 " down. 23 " up. 23 " down.	110	141 144 140 145 150 140 199 145	15.4 77 25 67 80 20 150 —	15.5 15.8 15.4 15.9 16.5 15.4 19.8 15.4	1.71 8.63 2.75 7.3 8.8 2.2 16.5 —	Direct current.	
2	Mason & Hamlin, 136 5th Ave.	May, 1894.	Magnet control.	58′–3″	125′	125′	125′	1500	275	7 h.p., 220 volts, 1,000 r.p.m.	2 people up. 2 " down. 3 " up. 3 " down. 4 " up. 4 " down.	240	49 6 47.5 50 49 52 48	5.5 8 5 8.0 6.0 10.0 4.0	11.9 11.4 12.0 11.75 12.48 11.5	1.32 2.04 1.092 1.044 2.4 0.96		
3	S. Stein & Co., 5th Ave. & 18th St	Feb., 1902.	Direct-regulated control by hand.	—	—	—	—	1500	—	230 volts, 75 amp., 630 r.p.m.	2 people up. 2 " down. 7 " up 7 " down. 14 " down.	240	74.8 77 43 72 66.5	21.6 32.5 10 12.5	17.95 18.5 17.3 15.97	5.18 7.3 10.3 2.4 3.0		
4	Transit Building, East 42d St.	Feb., 1901.	Magnet control, style 67.	121′–6″	300′	300′	300′	2000	500–600	220 volts, 100 amp., 800 r.p.m.	2 people up. 2 " down. 4 " up. 4 " down. 6 " up.	240	82 85 81.3 24 86	10.7 34 21.8 20	10.7 20.4 19.5 20.6	2.57 8.16 5.73 5.76 4.8		
5	Bryant Park Studio Building.	March, 1901.	Magnet control.	162′–10″	300′	300′	300′	1500	250	20 h.p., 230 volts, 800 r.p.m	2 people up. 2 " down. 4 " up. 4 " down.	240	82 83 83 2 81	29 22.6 36 18	19.7 19.9 20 19.45	6.97 5.43 8.65 4.32		
6	Aliman Apartment, 925 West End Ave.	May, 1899.	None.	75′–6″	150′	156′	151′	1500	250	2-phase motor, 200 volt, 60 cycles.	2 people up. 2 " down.	200	170	18	30.5	1.42	.89	.41
7	Katahdin, 567 West 13th St.	Dec., 1899.	None.	74′	125′	129′	124′	1500	600	2-phase motor, 200 volt, 60 cycles.	2 people up. 2 " down.	200	186 150	36 6	34.7 24	2.5 0.5	.92 .91	.34 .45
8	Wharfedale, 606 W. 115th St.		None.	—	—	—	—	1500	—	2-phase motor, 200 volt, 60 cycles. Variable speed, no load speed, 900 r.p.m.	2 people up. 2 " down. 3 " up. 3 " down.	200	172 170 193 —	33 6 29 29.2 30	30.8 29.6 29.2 30.0	2.66 1.15 2.96 2.00	.875 .845 .79 —	.4 .2 .413 .326
9	Foxhall, 116th St. & Amsterdam Ave.	March, 1902.	None.	74′–11″	150′	150′	150′	2000	300	2-phase motor, 200 volt, 60 cycles.	2 people up. 2 " down. 8 " up. 8 " down.	210	189 186 184 188	38 40 46 35	38 38 36 38	3.4 1.8 6.6 0.8	.95 .97 .93 .96	.43 .41 .68 .14
10	Elizabeth Apartment, 105th St. & Broadway.	1901.	2 Voltage control.	75′	200′	181′	185′	—	725	2-phase motor, 200 volt, 60 cycles.	2 people up. 2 " down. 3 " up. 3 " down.	60 175 60 175 60 175	122 146 104 132 113 152 104 144	4.4 6.4 11.2 2.0	8.5 14.6 8.6 14.4 — 2.0	1.6 1.0 2.0 0.4	Starting currents on points of control:	
11	Brambach Piano Co., 133d St.	June, 1901.	Rheostat control.	56′–6″	100′	2% variation with load	2% variation with load.	2000 freight	500	15 type F. 2-phase motor, 200 volts, 60 cycles.	1 man and car up. 1 " " " down 1200 pounds up. 1200 " down 2 people in car up. 2 " " down	200		36 70 29 26	25.2 23.6 25.2 23.6 25.2 22.6	4.8 9.4 4.4 2.0 4.7 8.5	1 2 3 4 70 90 60 140 70 70 80 130 70 90 60 140 70 70 80 130	

TABLE SHOWING RESULTS OF TESTS MADE UPON CHARACTERISTIC INSTALLATIONS.

power-factor. It will be noticed that the starting power-factor varies from 0.79 to 0.97, according to the load upon the motor. In contrast to this, the power-factor, while the elevator is running, varies from 0.14 to 0.68, the average being 0.36. This shows that the alternating-current motor is much larger than the average conditions would call for, but it seems necessary to provide this capacity in order to accommodate any heavy loads that may have to be carried on a few occasions. The inrush of current for the alternating-current motors is large as compared with the direct-current machines, especially in those cases where there is no control. In

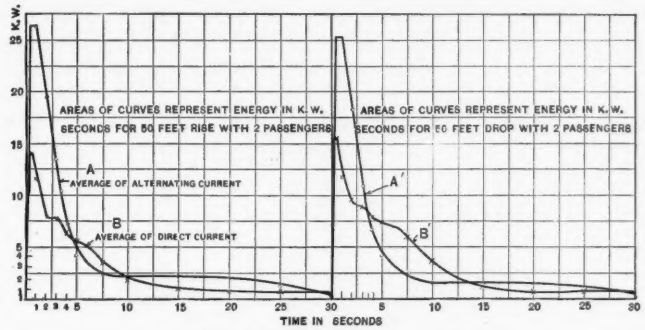
from 29.6 to 34.7 for the alternating-current machines. Test No. 11 would seem to indicate the method by means of which the power consumption for alternating-current motors can be decreased and thereby make the cost of operation less than it is at present for similar types of machines.

The above table simply indicates the actions of the various types of elevators, and it is not advisable to compare the two classes of elevators as to economy from the results shown. In order that a comparison might be made between all the tests which were conducted, curve sheets Nos. 1 and 2 were prepared.

paring the alternating-current curve A1 with the direct-current curve B1, we find a relation of 1.079 to 1, showing a power consumption for the alternating-current machines greater by about eight per cent. The curves for the direct-current tests are made from the results of five motors with automatic control, while the results for the alternating-current machines are made from six uncontrolled motors.

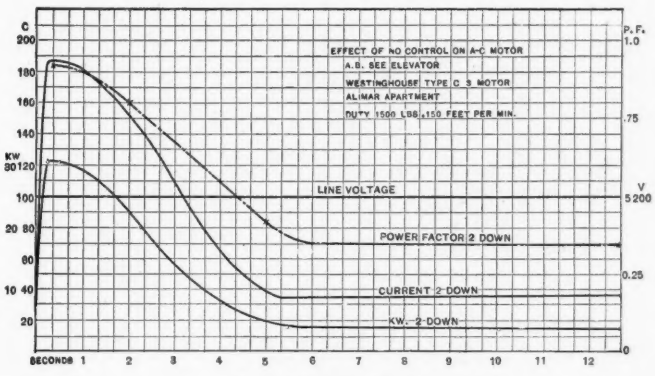
Curve No. 3 shows a typical alternating-current motor with no control. The starting current with elevator going down is 186 amperes, while the kilowatts at this point are 30.5. The course of the power-factor is interesting, it being 0.92 on start-

ing, rapidly falling to 0.35 when the elevator is running at a uniform speed. Curve No. 4 shows the effect of control on direct-current motors with a considerable overload. The current with twenty-three


K.W.
AREAS OF CURVES REPRESENT ENERGY IN K.W. SECONDS FOR 50 FEET RISE WITH 2 PASSENGERS
A
AVERAGE OF ALTERNATING CURRENT
B
AVERAGE OF DIRECT CURRENT
AREAS OF CURVES REPRESENT ENERGY IN K.W. SECONDS FOR 50 FEET DROP WITH 2 PASSENGERS
A'
B'
TIME IN SECONDS

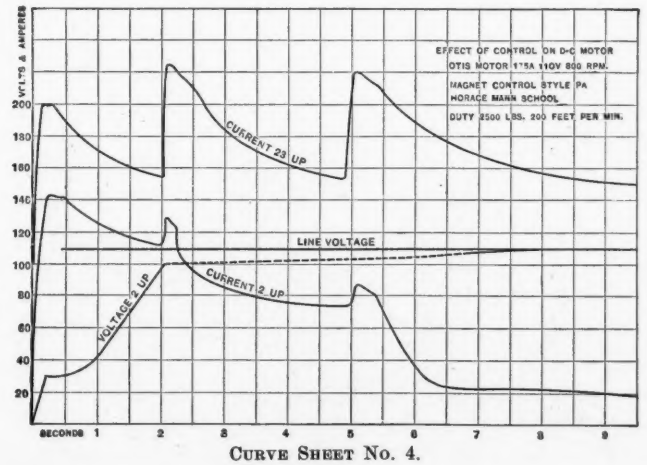
CURVE SHEETS NOS. 1 AND 2.

people in the car rose to 200 amperes and made an upward jump, reaching 225 amperes at the next point in the control.



CURVE SHEET NO. 3.

The variation in the voltage across the motor is shown by the voltage curve, and this record would seem to indicate that the



CURVE SHEET NO. 4.

resistances of the circuit could be increased to advantage.

With the cost of power at ten cents per horse-power-hour for both types of elevators, it would appear more economical to use direct-current elevators in those places where both direct and alternating current are available. If the controlling apparatus is more simple with the alternating-current system and the absence of a commutator on the motor can be counted as an advantage, the extra expense of operating an alternating-current machine might be offset by the decrease in repairs and attendance. Apart from the last considerations there seems to be every advantage in favor of the use of the direct-current motor.

TELPHERAGE.

BY CHARLES M. CLARK.

Definition—Telpherage is derived from two Greek words "τελε" and "ψερω." "Tele" means far, and "ferro" means to bear or to carry. Therefore, telpherage means far-carrying. The same word "tele" appears in telegraph and telephone. The word was originally invented by the late Professor Fleming Jenkin, who was the early spirit of telpherage, and but for his untimely death telpherage would be even more extensively used. Like many other words, its meaning has varied. In the beginning it meant, practically, aerial electrical transportation, but now it has been brought back to its original meaning, which is the transportation of material to a distance by electricity, overhead, or sometimes on the surface, or even underground. In the latter case, it is named "tubular despatch." Therefore, telpherage can be concisely defined as the electrical transportation of material. The method of applying it is an engineering problem and must depend upon local conditions, and even to-day the term "telpherage engineering" is becoming a common expression. It will be noticed that the word "automatic" is left out in these definitions. The reason for this is that it is a commercial question, and in cases where a man is required to attend certain portions of the work, it is often cheaper for the man to go with the load than to use automatic devices. As to whether it is better to make an installation automatic or otherwise depends entirely upon the comparative costs of the two methods of operation. In this connection it may be said that with telpherage plants the word "telpherman" is now often used.

History—The early history of telpherage closely resembles that of the electric railway. Before the successful pioneers in electric street-railway traction had finally accomplished satisfactory results, many men had experimented, and it is well known that, some forty years ago, an electric railway was operated, having a speed of several miles per hour. Is seems that it is necessary, with all successful applications of power to the transportation problem, that much preliminary work, seemingly unproductive, must be done. It often happens, as in the case of early telpherage, that the times were not ripe for its commercial adaptation. In the history of telpherage in England, a telpherage line was installed, using what was then called the series system, whereby it was necessary to use a telpher with a number of trailers. One section was positive and the next negative, the current passing from one section of the track to the other through the motor, thereby completing the circuit. In passing over the insulator between the positive and the negative sections, there necessarily occurred considerable sparking, which greatly increased the cost of main-

tenance. It was also necessary to always have trains of certain lengths. There were many other disadvantages, such as having to use a track made of round bar rail and

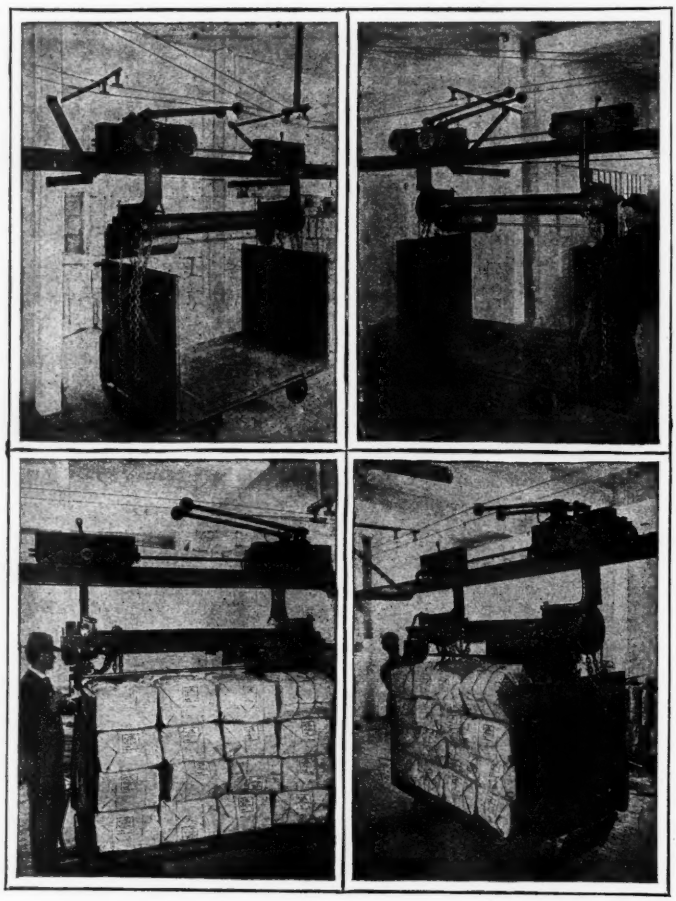


FIG. 1.

Side-bearing telphers with permanently attached trailer. Track, solid rail. Telpher controlled from either end. Length, 1,200 feet. Four curves, one "S" curve. Grade, 12 per cent. Maximum total, 4 0.0 lbs Speed on level, 10 miles per hour. Speed on grade, 5 miles per hour. Horse-power, 5-horse-power. Capacity, 100 tons per day per telpher.

the difficulty of manufacturing reliable electric motors. If it was desired to install a telpherage plant, it was always necessary to put in an engine, boiler and dynamo. In comparison with its early history, telpherage to-day possesses the advantage that every factory, where there is need for telpherage, either has its own electrical plant or the power can be rented from existing central stations or even street railway stations. There are also to-day for aerial transportation most excellent cables made especially for telpherage work, and likewise where it is more desirable to use than solid rail cable, special shapes have been devised which give most excellent results. Motors, controllers and carriers of great reliability are now manufactured following the methods developed by the best railroad practice.

Before it was decided to enter into the present commercial adaptation of telpherage, an engineer visited all the electrical manufacturing plants and electrical installations in Europe, and found that nothing was being done in the transportation of material electrically. In the United States many experiments had been made, but the inventors were always seeking the unobtainable. Upon careful research, it was found that there were 450 patents directly applying to telpherage and several hundred more which pertained indirectly to this subject. Most of these original inventors were, however, too ambitious, and there was hardly any limit to the number of miles per minute which was to be achieved by the new and wonderful agent, electricity. Not only material was to be transported, but also passengers, and beautiful cars of mahogany were built and put in experimental operation. Cigar-shaped carriers were devised, some of which made a speed of two miles per minute or more, and when it was impossible to attain a greater speed there was great discouragement. There are no authentic examples of much more than experimental work, namely, merely conveying material between two points, generally in a straight line, placed in some vacant lot or loft, and there seemed rather to be a desire to force the method of transportation according to certain preconceived ideas, rather than to pay the necessary attention to its commercial adaptation.

Construction—On account of various advantages in regard to the distribution of material—such as depositing at an elevation—most of the telpherage plants thus far installed have been overhead. As engineers, you may be mostly interested in hearing what has been accomplished; the descriptions are, therefore, confined to overhead work. Under the head of construction, it may be stated that the track is made of cable, especially drawn, either of standard wire or lock coil type, which latter has a strength approximating ninety-five per cent that of the solid bar, or else solid rail, either of flat, girder or bulb type.

The cable tracks are supported every 100 feet, provided it is convenient to erect poles or structures. Where there are deep ravines or between upper stories of factories, the span is made to correspond with the distance, and can be made of any reasonable length. In addition to the track cable, upon which the telpher runs, there is also what is known as the suspension cable. As is well known, it would be impossible to prevent considerable sag in the

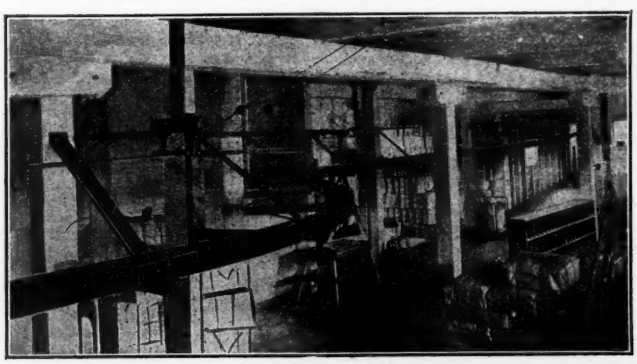


FIG. 2.—SHOWING TRACK WITH "S" CURVE.

track cable, and therefore the track cable is suspended from this suspension cable by means of hangers. The number of these hangers would depend upon the length of the spans. It will be easily seen that it is possible to have the centre of the spans higher than the ends by merely raising the suspension cable and the hanger. This obviates one of the early difficulties met in the use of cable for telpherage, as there is now no objectionable deflection in the cable when the telpher approaches a bracket. There are several methods of connecting the track and suspension cables by means of the hangers. The sizes of the cable, hangers and brackets vary, depending upon the weight which comes upon each individual span. The support was either simple poles with a bracket, or what is known as the "A" construction or ordinary cross-bents. Cable construction costs less than solid rail, except where there are many switches, in which cases the price of solid rail and cable approach each other. In general, cable for straight lines is recommended except where the weight is excessive.

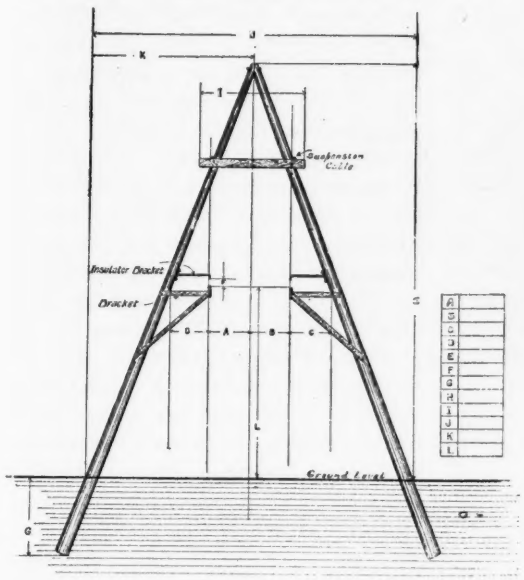


FIG. 3.

Supporting pole, double line. One of the simplest methods of pole construction for double lines. Especially recommended for long lines and where trees are available.

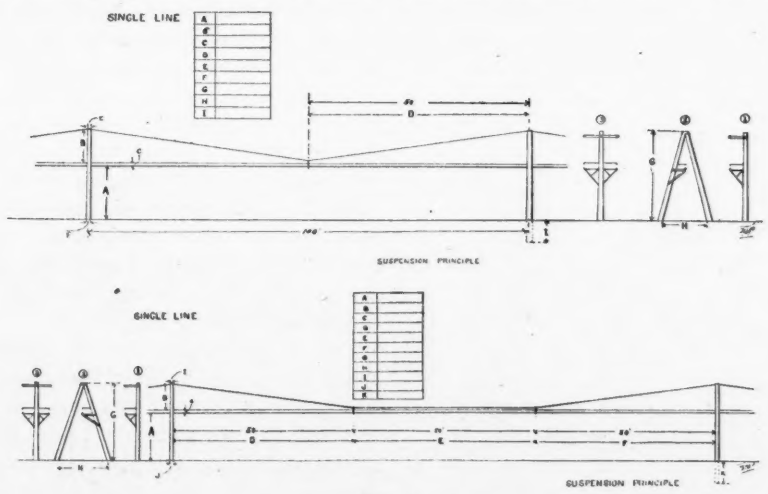


FIG. 4.

Other forms of pole construction, showing single and double lines. The track cables are supported by another cable, which is called the suspension cable. It would be impossible with long spans to stretch a cable so that under load there would not be considerable deflection. This deflection or sag is taken up by the suspension cable. Not only can we make the track cable horizontal, but even higher in the centre than at the terminals.

In solid-rail construction the supports are ordinarily placed sixteen to twenty feet apart; longer spans are used if it is not convenient to erect supports. On long spans, the track consists of a girder rail with the track rail above it. It is not possible to give any general rule as to what kind of track it is advisable to use, as this is a factor of the length of the spans and the weight. The weights conveyed thus far by the telpherage vary from 125 to 10,000 pounds, and the cost varies accordingly. It will be readily understood that when the weights are greater, the supports must be nearer together and the cables or girders heavier. Running parallel to the track rail, either above or at the side, and depending upon the amount of head room, are stretched one or more trolley wires; one wire, if the track be used as a return. If, however, it is desired not to use the track as a return, or to use alternating current, two trolley wires are employed. There are many other details of construction, but the photograph and outline drawings will serve to illustrate better than any description.

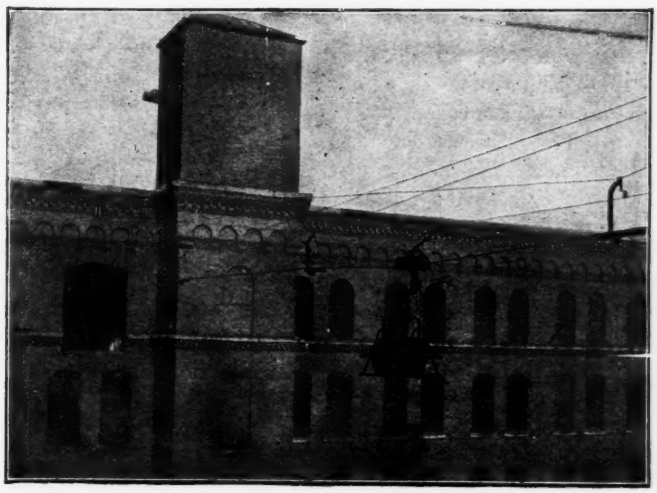


FIG. 5.

Cable construction, Pittsburg, Pa. Line 97 feet from the ground, illustrating suspension-cable, track-cable and hangers.

(To be continued.)

Long-Distance Heating Plant.

There has been completed at Dresden, Germany, one of the largest long-distance heating plants in Europe. This is used on many public buildings on the left bank of the River Elbe, including the theatre, museum, castle, royal kitchen, the custom house, etc. The greatest distance from the central station over which the heat is transmitted is three-quarters of a mile. The total heat consumption per hour is 15,200,000 heat units. The usual steam pressure is two atmospheres. Ten of a total of fourteen boilers are used, and to guard against accidents two main lines of pipes have been provided. It is stated that the loss of heat in transmission is from four to four and one-half per cent. The largest pipes have a diameter of eight and one-half inches. The pipes are protected by two layers of tin, the inner layer being perforated and the outer one covered with silk.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CXXXVIII (*Concluded*)—VACUUM REGULATORS.

Probably Crookes was the first to make a good vacuum regulator by placing caustic potash in a small bulb connected with the vacuum tube.

Such regulators work with heat, either from a spirit lamp, a gas jet or a wire heated by a low-voltage current.

When attempts were made to operate them by the same high-voltage current used to excite the X-light tube it was found that when the resistance of the tube was high it was impossible to get any current through the regulator. That is, under the conditions when there was most need of the regulator it would not work. Therefore, in 1896, there was designed a regulator in which the chemical was mixed with a conducting powder. This arrangement reduced the resistance of the regulator so much, forming minute spark-gaps throughout its substance, that the current would go through it at all stages of the vacuum. Such a regulator is shown in Fig. 1. It keeps the vacuum at any desired point, this being decided by the length of spark-gap in the circuit. The regulator is as efficient as the more recent and elaborate ones in which the high resistance is overcome by having the discharge take place in a supplementary bulb with a lower vacuum which is attached to, but does not communicate with, the X-light tube. It has the advantage of not being patented. Since Trowbridge has advanced the theory that X-light is produced by the heat of the dissociation of water vapor at the target, and not by the heat of impact of the subatoms of the cathode stream as stated in these notes, water vapor regulators are of more interest. Therefore one of this type has been chosen for attachment to the tube illustrated here, though a number of men prefer the oxygen regulator (note xxiii, February 9, 1898), while others like the hydrogen regulator (note lxxix, December 20, 1899), or the nitrogen regulator (note xcvi, May 30, 1900).

The intermolecular regulator (Figs. 52 and 57, note lxii, April 26, 1899), whether operated by heat or electrolytically, has received little attention in this vicinity. In regard to regulators of any type, however, we are still in the condition described in note cxxi (March 9, 1901), no advance having been made toward restoring the pristine brilliancy of a tube, though as we increase the power of our generators such advance is to be desired. With all regulators controlled by a spark-gap in a high-voltage current there is a disagreeable snapping noise from the spark when the regulator is in action. This noise may be stopped by placing the spark-gap in a glass tube like the one figured in note cxii and used to stop the greater noise of the main spark-gaps. The special form of tube shown in the illustration accompanying this present note was designed by Mr. John O. Heinze, Jr., who modified the capillary spark-gap of Mr. W. S. Andrews for this purpose. He expanded the central part of the tube because it diminished the risk of the tube cracking from the heat of the discharge.

LENGTH OF X-LIGHT TUBES.

The earlier X-light tubes were short, generally not over ten centimetres, but as generators with higher potentials became more common the tubes were made longer. The increase in length diminished leakage around the tubes. At the present time makers vary in regard to the length of the tubes they send out. Many still furnish short tubes, while others make them twenty or more centimetres long. The length of the one shown in the figure (fifty-six centimetres) will no doubt be considered excessive.

DIAMETER OF X-LIGHT TUBES.

The early tubes had a diameter of from four to seven centimetres. In this respect there has been a general improvement. The tendency at the present time is toward a globular bulb about seven to ten centimetres in diameter, though bulbs as large as sixteen centimetres are sometimes made. This increase in size has been due to the recognition of the need of storage capacity to prevent the vacuum from falling quickly in use, thus making the light of too long waves to be useful. There are certain advantages in still further increasing the storage capacity to further retard the coming on of a low vacuum. Therefore, the idea of a supplementary bulb, invented by the French in 1896, to supply a source of fresh gas to prevent the vacuum rising in use, may be employed for another purpose, that just mentioned, because in this way we double the capacity without increasing the diameter of the bulbs. When we consider that a bulb of ordinary size has to stand an atmospheric pressure of over a ton, and that at its thinnest parts, through which the light from the target comes to the patient, the glass should not be over forty-three one-hundredths of a millimetre; the advantage of not increasing the size of the bulb is apparent. Another way is to make the bulb oval, using longer and larger tubes for the ends, for this increases the storage capacity without destroying the symmetry of the tube or increasing the size of the thin part of the bulb. Therefore, the tube is better able to bear the increased pressure as this comes against thick glass.

LENGTH OF TERMINALS.

The early tubes had the stems of the cathodes short, about two millimetres in length, and wrapped in glass. It was thought this construction gave more X-light by causing the electricity to be discharged from the front surface of the cathode. When wandering in a wilderness of obscure phenomena the best way to get out is to push each effort to the extreme. Therefore a cathode was made in which not only the stem but the entire surface of the back of the cathode was coated with glass. The stem and the back of the cathode were made of platinum, uranium glass being melted onto it. The face of the cathode was made of aluminum as usual. Such a construction offered no particular advantages sufficient to offset the extra cost. Therefore in future designs all idea of confining the discharge to the front of the cathode by short stems and glass wrappings was abandoned. Tube-makers have never taken advantage of these experiments, continuing to supply tubes with cathodes having short and slight stems, wrapped in glass to support them, thus making the tubes very delicate. Powerful currents are fatal to such tubes. Having found by experiment that the cathode stem might be of any length, and bare, without injury to the tube, long stems were used when the cooled target tube was constructed, because while it was important to have the tube long, it was also desirable to keep the anode end short for mechanical and financial reasons. When the double-cooled tube, shown in note i, was constructed there was no difficulty in making the face of the target cold, however long the tube of the target might be. As it was afterward found that the only part of the outer tube which needed to be of platinum was the end near the face and a short piece where it was sealed into the glass, the balance being made of copper or of silver, there is no longer any reason why the length of the arms of any type of tube can not be the same. As a tube in which the bulb is in the middle is more symmetrical, this type has been chosen for the illustration accompanying this note. Aside from the increased storage given to tubes by in-

creasing the length and diameter of the arms, the length is an advantage, as it gives a better opportunity to hold the terminals in line. This is especially the case with sliding terminals. This consideration alone is sufficient to warrant such a construction.

SINGLE *vs.* DOUBLE FOCUS TUBES.

Vacuum tubes are by English-speaking men generally called Crookes tubes, whatever their form; by Germans—Hittorf, Geissler, Plucker, Hertz or Lenard tubes. As usual in historical matters the Germans are more nearly right, for much work had been done before Crookes, though as not one of the men mentioned invented vacuum tubes there is no reason why they should, as a class, be called after any of them. Where the special kind of vacuum tubes now almost universally used for X-light are concerned (those in which the cathode stream is brought to a focus on a piece of platinum), there is more reason why these should be called Crookes tubes, for Crookes appears to have invented them. The modification of the Crookes tube in which the target is placed between two concave cathodes, which Rœntgen described in his paper of March 9, 1896, appears to have been new at that time and might well bear his name. Rœntgen tubes are, however, not required even for alternating currents. Besides, alternating currents use up a tube faster for the amount of light yielded, therefore at the present, until we learn how to easily keep a tube youthful, such currents are not desirable. Moreover, at the present time it is not as easy to control the quality of the light produced by a tube excited by a high-frequency current as it is where the tube is lighted by a coil of the type figured in note cxxxvii. For these and other reasons, the type of tube chosen for the illustration of the paper is the Crookes or single focus.

Electrical Patents

Mr. Henry G. Reist, of Schenectady, N. Y., has been granted a patent on a connector for spools of dynamos, the patent having been assigned to the General Electric Company. The object of the invention is to provide a simple and reliable means for connecting the windings on adjacent spools, especially in machines of the revolving-field type. It is found that where the distance between the spools is of some length the effect of the constant vibration, together with the centrifugal force of the rapidly rotating field structure, is to put such vibrating, bending and other strains upon the ordinary flexible connectors that they soon break, thus causing frequent stoppages for repairs. This invention obviates this difficulty by providing a connector which is rigid enough to resist all bending strains and yet light enough not to exert too great a centrifugal pull on the winding terminals. Moreover, it does away with the necessity of providing a support for the connector. The field-spools A

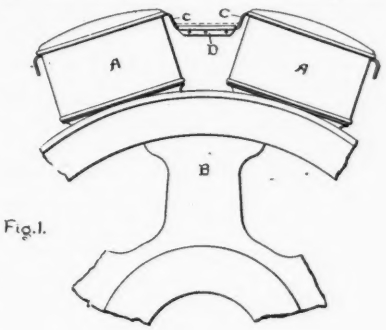


Fig. 1.

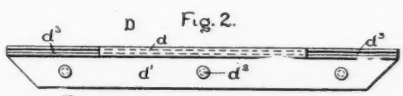


Fig. 2.

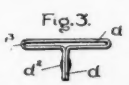


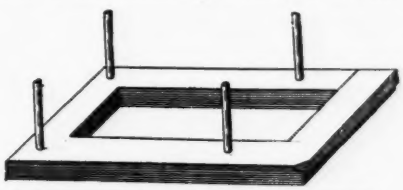
Fig. 3.

IMPROVED CONNECTOR FOR SPOOLS OF DYNAMOS.

are carried on the rim of the wheel or spider B. The terminals C of the windings on said spools are connected to a light rigid connector D, preferably made of sheet metal. The windings are usually flat copper ribbons, so that the connector D is preferably provided with end sockets of corresponding form to receive said ribbons. A convenient mode of making the connector is to double a strip of copper into a flat tube *d*, the meeting edges d^1 being turned outwardly at right angles to the tube and secured together, as by rivets d^2. This makes a webbed T-shaped structure of great stiffness. At one or both ends the tube *d* may be cut away on one side, as at d^3, to enable the corresponding terminal C to be slid in without special fitting as to its width. The terminals may be soldered to the connector or otherwise secured to give a good electrical connection. The terminals are bent inward toward the wheel B, so that their tips are bent almost at right angles to enter the connector. The inwardly turned portions resist the outward thrust due to centrifugal force, while the rigid connector prevents all vibration and avoids the necessity of using a support. It is evident that many different shapes of connector may be devised, the essential feature being to have a rigid light structure.

In 1896 Mr. Walter S. Moody, of Lynn, Mass., obtained a patent on a transformer. As described in that patent the coils were first wound on two bundles of straight laminæ having tongue and groove ends, which bundles, with the coils wound thereon, were then placed a suitable distance apart and their ends joined by short bundles of laminæ to complete the magnetic circuit. One end of each short bundle interlocked with the tongue and groove end of the long bundle which constituted one leg of the core. The other end of each short bundle abutted against the side of the long bundle which constituted the other leg of the core. This proved a very cheap and convenient mode of constructing a durable and efficient transformer. However, there was a not inconsiderable core loss in transformers constructed in the above manner, which was due to the fact that there were necessarily four joints between the laminæ.

Mr. Augustine R. Everest, also a resident of Lynn, Mass., has just obtained a patent on an improvement in this line, and transformers have been made in accordance therewith, which show a reduction in core loss of over five per cent with respect to transformers constructed as described above. This is a very conservative estimate. As the core loss of a transformer continues independently of translating devices in the secondary circuit, it is clear



IMPROVED TRANSFORMER CONSTRUCTION.

that such a reduction is material and important. This result has been obtained by reducing the number of joints between the laminæ so that a better magnetic circuit is obtained. The core made in accordance with this invention is built up of substantially U-shaped laminæ, each of which has a long and short leg. The coils are wound independently and are afterward slipped over the legs of the U-shaped core, which is left open at one end for this purpose. The number of joints between the laminæ can be decreased by this construction, so that the fixed core loss will be considerably reduced, and transformers having cores made in this manner have been uniformly efficient in operation and economical in manufacture. Both patents are controlled by the General Electric Company.

News from Great Britain.

(By Our Special Correspondent.)

THE question of locomotion in England, and the continually growing necessity for increased facilities for the relief of congested areas from a health point of view has been a subject of much discussion for some time past. As is well known now, London is without doubt the worst served city in the kingdom in the matter of means of communication, and the action of the Joint Committee on Underground Railways last session in delaying for a whole twelvemonth a large batch of proposals for tube railways has been most adversely criticised at various times. However, the announcement of the appointment of a House of Lords committee (under the same chairman as last year's joint committee) to deal with fourteen bills for underground electric lines in and around London has awakened interest in this branch of the industry. In this connection it is instructive to draw attention to a paper recently read before the Society of Arts by Mr. Clifton Robinson, managing director of the only line of electric tramways at present existing in London. This paper dealt exhaustively with the present state of legislature as affecting electric traction and gave a most succinct account of the existing state of the industry in London, such as is not often gathered together in tabulated from. We have at present in London but three lines in operation—*viz.*, the City & South London, opened in 1890; the Waterloo & City, opened in 1898, and the Central London, opened in 1900. These total up to fifteen and three-quarter miles, in addition to which there are thirty-six and one-half miles now being constructed. A feature not very generally known is that the Great Northern & City line is being built with tunnels sufficiently large to allow ordinary railway stock to run over its lines, a thing prohibited on all other tube lines owing to the smallness of the tunnels.

A piece of legislature which has been greatly exercising the minds of the electrical profession is the inclusion of electric generating stations in the Factories Act, by which these places now come under the head of factories and—not hitherto the case—also under the supervision of the Home Office inspectors. A good deal of a soothing nature, however, has been accomplished by the appointment of Mr. G. S. Ram, a member of the Institution of Electrical Engineers, as chief electrical inspector under the new act. Under the old régime the Home Office inspectors have not had any experience of the conditions obtaining in generating stations, and it is well that they have not been permitted to exercise their sweet will in this new capacity unrestrained. The Institution of Electrical Engineers has agitated a good deal in the matter, and the appointment of Mr. Ram is in some measure traceable to the attitude taken by this body at the instance of its members.

As I recently mentioned, the Nernst lamp is now on sale in this country, being imported here from Germany. Some interesting data *apropos* of the electric lighting commodity were given in a paper read before Birmingham local section of the Institution of Electrical Engineers. In this the author deals with some experiments he has made with a lamp on continuous-current circuits. He says that the Nernst lamp gave an average of 0.48 candle-power per watt expended during a life of 400 hours, as against 0.28 candle-power per watt in the case of a good glow lamp. The cost of renewals would appear to be not more than three times as much for the Nernst lamp as for the glow lamp, allowing for the shorter life of the former. In a 100-watt Nernst lamp the total energy used was thirty-five units during economical life, and at fourpence per unit the cost came out at eleven shillings and eightpence, or, say, not more than fifteen shillings when all the expenditure due to the renewals of the burner is taken into account. Thus the Nernst lamp was found capable of furnishing 1,000 candle-power-hours at the cost of elevenpence as against fifteenpence in the case of a good glow lamp. It will be interesting to see how these results agree with those of other tests.

The following further details of Mr. Henry Lea's report on the surface-contact system of the Lorain Steel Company, at Wolverhampton, mentioned in my last notes, are of interest. A fifteen-ton steam roller was driven over a number of the studs without occasioning any disturbance or cracking. The main leakage to earth was found to be about 0.1 ampere over seven-eighths of a mile of track. During a thirty-day trial by the borough engineer, at Wolverhampton, no less than 49,392 passengers were carried, the receipts amounting to £206 16s. During this time 4,298 car-miles were run. Each stud box was tested daily to trace any electrical pressure on the contact stud after a car had passed, but in no instance was one found to be "alive," except on two occasions when less than one volt was traced.

In all questions concerning municipal trading advocates on either side seem at a loss as to where to draw the line between rate aided trading and private company trading. But a somewhat glaring instance of the applicability of tramways and omnibuses to municipal management has recently been afforded Londoners in connection with the London County Council tramway service south of London. When these lines came into the possession of the council, the latter also absorbed a number of omnibuses feeding the tramways from certain railway termini north of the Thames. These were run at halfpenny fares and an almost perfect service was given. But a sharp-witted lawyer on the side of the other omnibus companies in London has discovered a flaw in the terms of the London County Council's tramway powers which was put forward as precluding the latter body from running omnibuses. This view has been legally upheld, and the council's omnibuses have been stopped. A number of private omnibus owners have continued the service, but it bears no comparison with the former state of affairs, and complaints are rife.

Mention of the London County Council tempts me to record the fact that that body is now utilizing Marconi's wireless telegraph system between several of its London fire-brigade stations. Marconi's company some time ago put up the installation experimentally, but an agreement has now been entered into on the basis of a yearly rental.

St. Paul's Cathedral, which recently was the recipient of a munificent sum of money from Mr. Pierpont Morgan to be devoted to the electric lighting of the edifice, was so lit for the first time at Easter. The final installation is to consist of 2,000 glow lamps, but only the first portion of the work has as yet been completed.

A. W.

London, April 9.

GENERAL ELECTRIC ANNUAL REPORT.

A HIGHLY SUCCESSFUL YEAR.

The tenth annual report of the General Electric Company for the fiscal year ending January 31, 1902, was sent out last week. It shows that the company has had a year of great prosperity. The present directors are Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., Frederick P. Fish, George P. Gardner, Eugene Griffin, Henry L. Higginson, J. Pierpont Morgan, J. P. Ord, Robert Treat Paine, 2d, George Foster Peabody, Charles Steele.

Under date of April 21, 1902, President C. A. Coffin reports to the stockholders as follows:

The profits of the company for the past year (including a profit of $938,584.77, derived from the sale of securities), after deducting all general, patent and miscellaneous expenses, expenditures of $1,131,583.98 on factory plants and machinery, and allowances for depreciation and losses were $8,598,241.34.

Dividends on preferred and common stock and interest on debentures	$1,997,966 40	
		$6,600,274 94
Increase in the value of stocks and bonds owned by the company	$2,057,685 07	
Added to surplus account	$8,657,960 01	

Full details of the business in the selling and manufacturing departments may be found in the reports of the first and third vice-presidents.

The financial report of the treasurer and general auditor is also submitted.

Attention is especially called to the result of the recent revaluation of the securities owned by the company.

After reducing the book values of certain items in the securities a net increase of $2,057,685.07 is shown in the aggregate book value thereof. Besides this increase in value the company has realized as net profit from sales of sundry stocks and bonds during the past four years an amount in excess of $2,500,000.

Apart from these profits, it has collected in interest and dividends from said securities during said four years additional amount of $1,140,000, or about four and one-fifth per cent per annum upon the book value thereof.

The greatest praise is due to the members of all the departments of the company for the manner in which they have discharged their duties during the year in which the pressure of work and responsibility has been especially severe.

First Vice-President Eugene Griffin presents the following report upon the operation of the sales department:

Total sales (amount billed to customers)	$32,338,036 64
Cost of sales	25,254,122 00
Profits on sales	$7,083,914 64

The yearly orders for the past eight years as contrasted with the amounts billed to customers are as follows:

Year ending Jan. 31.	Amounts billed.	Orders received.
1895	$12,540,395	$12,160,119
1896	12,730,058	13,235,016
1897	12,540,994	11,170,319
1898	12,396,094	14,382,342
1899	15,679,430	17,431,327
1900	22,379,463	26,323,626
1901	28,783,275	27,969,541
1902	32,338,036	34,350,840

Since February 1, 1900, the orders received have not included the items of services of experts and labor, freight and transportation, supply material, boilers, engines, etc., of outside manufacture and bare copper wire, which items were included prior to 1900. These items amounted to $1,828,962 during the past year.

The orders received include:

Generators and rotary converters, capacity, about 350,000 kilowatts; railway motors, capacity, over 600,000 horsepower; other motors, capacity, over 150,000 horse-power; transformers, capacity, over 200,000 kilowatts; incandescent lamps, over 15,000,000. During the past year we have received orders for 55,000 horse-power in generators (including three of 10,000 horse-power each) for the Niagara Falls Power Company, to be used by it both on the American and Canadian sides of the river.

One thousand eight hundred railway motors (125 horse-power each) for the complete motor equipment of the Manhattan Elevated Railway, New York city; also control equipments and air compressors therefor.

The entire equipment of the tramways of Tokyo, Japan, including 3,600 kilowatts in generators, 250 car equipments and all accessory apparatus. This will be the largest electric plant in Asia.

The electrical equipment of several high-speed interurban railways connecting important cities.

Included in the amounts billed are: 5,760 horse-power of generators and 4,200 horse-power of motors for the Mysore installation in India which utilizes the water power of the streams from the western Ghauts and transmits the power ninety miles to the Kolar gold fields; 3,000 horse-power of generators, 4,700 horse-power of rotary converters and 12,800 horse-power of railway motors for an electric railway connecting Milan, Gallarate and Varese, Italy, this road now being operated by steam. More than 9,000 motors of various sizes for the operation of machine tools, blast and ventilating blowers and fans, air pumps, air compressors, hoists, printing-presses, linotypes and other typesetting machines, circulating and lifting pumps, refrigerating machinery, cash-carrying systems, for controlling valves at a distance, for the operation of conveyors, motor-generator sets, engine governors, large electric switches and rheostats, movable stairways and platforms, and elevators, the training of heavy ordnance, etc.

As further illustrating the various uses of electricity the following is a list of chemicals for the production of which electrical apparatus was sold during the past year:

Aluminum, carborundum, calcium carbide, corundum, graphite, sponge lead, alkalies, ferro-titanium, sodium, potassium chlorate, barium hydrate, barium cyanide, phosporous, ozone, chromium, ferro-silicon.

The following is a list of ships on which we are now installing electrical equipment or which we have completed during the past year: Battleships Maine, Missouri, Georgia, Nebraska and Indiana; monitors Arkansas, Florida and Nevada; cruisers Prairie, Raleigh, Yankee, Rainbow, Detroit, Panther, Olympia, Denver, Chattanooga, Cleveland and Des Moines; gunboat Machias; torpedo-boat destroyer Stewart; torpedo-boat Wilkes; transport Crook; S. S. Korea and Siberia for the Pacific Mail service, and a large number of merchant vessels.

The successful operation during the year of transformers at 80,000 volts renders practicable the use of hitherto unavailable water powers and the transmission of power therefrom over distances of 200 miles or more in competition with coal.

We received about 160,000 separate orders during the year (not including contracts), an average of 528 per day. Current orders have gradually increased from 380 per day in 1897 to 528 per day in 1901.

It has been the rule of the company to sell for cash, and our standard terms call for cash payments within sixty days of shipment. The actual record for the past five years is as follows:

Year ending Jan. 31.	S/D Attached to B/L. Per cent.	30 Days. Per cent.	60 Days. Per cent.	90 Days. Per cent.	Over 90 Days. Per cent.	Stocks and Bonds. Per cent.
1898	20.9	41.9	22.8	4.6	9.8	0.0
1899	28.8	35.7	18.7	8.9	6.1	1.8
1900	12.9	61.6	12.5	10.0	3.0	0.0
1901	17.7	57.9	11.5	8.4	4.3	0.2
1902	12.3	65.6	11.4	6.3	4.3	0.1

There has been no important change in the organization of the sales department during the year. Much credit is due the department and local office managers as well as the selling agents in the field for the excellent results of the past year and for their loyal and successful work.

Third Vice-President E. W. Rice, Jr., presents the following report on manufacturing and engineering for the fiscal year:

MANUFACTURING.

The continued increase in our business has required further expenditures during the year for extensions to existing buildings and the erection of new ones and for additional machinery, aggregating about $1,500,000, exclusive of the cost of patterns, small tools, etc.

At the Schenectady works, the pattern shop of 52,000 square feet, and the additions of 70,000 square feet to our machine shops, mentioned in my last report, have been completed.

We are now erecting buildings for the manufacture of wire and cable and insulating materials, of 180,000 square feet; a machine-shop for large work of 117,000 square feet; a building of 60,000 square

feet to increase our facilities for manufacturing switches, controllers and other small articles; and an addition of 13,000 square feet to our testing shop.

The building now used as our general office at Schenectady was originally designed for manufacturing purposes, and is suitable for such purposes. The new office building, which has been under construction for the past year, will soon be completed and the present building utilized for manufacturing, adding about 40,000 square feet.

We have also begun an extension to our shipping department, which will add 30,000 square feet, and a new power-house, which will add 6,000 horse-power to our present equipment.

At the Lynn works our machine shop and testing facilities were increased by the addition of a building having 25,000 square feet of floor space; substantial additions were made to the power plant, and plans are now being prepared for a building of 55,000 square feet floor area for the manufacture of meters and instruments.

At the Harrison works, the fireproof storage building of 68,000 square feet area, mentioned in my previous report, was completed during last summer, and plans are being prepared for further substantial additions to our manufacturing facilities to take care of the increased sales of incandescent lamps.

The floor area of all our factory buildings is approximately 2,500,000 square feet, which will be increased this year about 400,000 square feet by the buildings now under construction.

The number of employés in all the works is about 15,000.

The erection by the British Thomson-Houston Company of large works at Rugby, England, will be of assistance to our manufacturing facilities, as that company has hitherto been principally supplied by our works in this country.

ENGINEERING.

During the past year there has been a continual increase in the size of electrical units and a great extension of the useful field for electrical apparatus. We have recently closed an order for several electric generators, each of a capacity of 10,000 horse-power, which are fifty per cent larger than any machines heretofore built. These mammoth generators are to be used in a new power-house at Niagara Falls, and the large size was adopted because of the lower relative cost and the saving in hydraulic and other engineering work. The machines are of the same general type as those which have been standard with us for several years.

We have also taken an order for five 5,000-horse-power generators for Niagara Falls, making a total of eleven machines of this size ordered for use at that plant. These are interesting because they are of the design of our own engineers, whereas the first six mentioned in my last report follow the designs of outside engineers. Our design was finally adopted because of lower cost and general excellence.

We have also designed and furnished during the past year some of the largest continuous-current generators in use in the world. These machines have proved entirely successful.

There has been a notable increase in the mileage and importance of electric railways due to the consolidation of adjoining systems and the development of high-speed interurban lines. Steam railroad managers are showing more interest in electric traction, and our engineers have carefully studied the problems presented by large terminals and heavy traffic conditions.

We secured the order for the electrical equipment of trains for the Manhattan Elevated Railroad, of New York city, which called for the construction of 1,800 125-horse-power motors. This contract was awarded to us after severe competitive trials of motors of other manufacturers. We are employing on this road the system of train control which was mentioned in my last report, and has now been in operation for several years; it has been standardized and is highly successful. It simplifies the control of an electric train and permits of its ready subdivision into one or more units. The same method of motor control is being used in connection with the electrical operation of hoists, printing-presses and similar work.

Over 100,000 horse-power of alternating-current generators have been designed and shipped during the past year for general power distribution. Electrical energy is now commonly transmitted over distances from fifty to one hundred miles with commercial economy.

We have installed during the past year transformers to be operated at 80,000 volts, which is the highest pressure for which transformers have been commercially built; the highest previous was 60,000 volts.

There has been a great increase in the size and number of electric motors for power purposes. We have now under construction a large number of motors of sizes ranging from 500 to 1,000 horse-power.

The application of electric power to the operation of textile mills, machine shops, mining plants and all classes of machinery, is rapidly increasing. Manufacturing plants covering large areas are rapidly adopting electricity for distributing power, because it is now a recognized fact that there is no other method of distributing power over large areas comparable in economy or effectiveness. Even in small plants, where efficiency of transmission is relatively unimportant, the use of electric motors is found profitable because of the increased output obtained.

The manufacture of electric locomotives has shown a satisfactory increase largely due to the excellence of our designs. This is also true of our work for the navy, merchant vessels, shipyards, dry docks and similar structures.

Our engineers have also been extremely successful in perfecting and developing the various small articles of our manufactures, such as arc lamps, meters, instruments, switches and controllers.

Applications for letters patent have been made for numerous new and important engineering designs and devices.

Although our engineers have always been liberally supplied with every facility for the development of new and original designs and improvement of existing standards, it has been deemed wise during the past year to establish a laboratory to be devoted exclusively to original research. It is hoped by this means that many profitable fields may be discovered.

The original, ingenious and successful work of our engineers commands our admiration, and we take pleasure in commending the unusually effective and economical work of our factory managers.

Treasurer Henry W. Darling and General Auditor Edward Clark present a financial report in detail. The summary is as follows:

CONSOLIDATED BALANCE SHEET OF JANUARY 31, 1902.

ASSETS.		
Cash		$4,058,448 00
Stocks and bonds	$9 825.120 93	
Real estate (other than factory plants)	464.195 68	
Notes and accounts receivable	11.364.345 05	
Work in progress	1.338.258 93	
	$22,991,920 59	
MERCHANDISE INVENTORIES:		
At factories	$7,742.605 55	
At general and local offices	1,037,968 16	
Consignments	96,309 47	
	$8,876,883 18	
		$31,868,803 77
Factory plants	$4,000,000 00	
Patents, franchises and good will	2,000,000 00	
		$6.000.000 00
		$41,927,251 77
LIABILITIES.		
Five per cent gold coupon debentures	$372.000 00	
Accrued interest on debentures	3,100 00	
Accounts payable	1,349.335 33	
Unclaimed dividends	4,775 79	
		$1.729.211 12
Capital stock		24,910 900 00
Surplus		15.287,140 65
		$41,927,251 77

CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1902.

EXPENSES.		
Cost of sales		$25,254.122 00
Interest on debentures		42,309 89
Dividends paid:		
On common stock	$1.871,968 00	
On preferred stock	83.688 51	
		$1,955,656 51
Surplus at commencement of year	$6.629.180 64	
Undivided earnings now added to surplus	8 657.960 01	
Balance January 31, 1902 (surplus)		$15,287.140 65
		$42,539,229 05
EARNINGS.		
Balance January 31, 1901 (surplus)		$6.629 180 64
Sales	$32.338,036 64	
Royalties and sundry profits	141,391 33	
		$32,479,427 97
Dividends and interest received on stocks and bonds owned	$259.094 24	
Interest and discount	175.256 36	
		$434.350 60
Profit on sales of stocks and bonds		938 584 77
Enhancement of book values of stocks and bonds		2.057,685 07
		$42,539,229 05

Two Patents Applied for in 1885 and 1887, Just Issued.

Two important patents have been issued recently relating to the distribution of alternating currents of electricity by means of transformers.

One of these is a patent granted on April 22, 1902, upon the invention of Professor Elihu Thomson, and is numbered 698,-156, and the other is a patent granted on March 16, 1902, upon the joint invention of Professor Elihu Thomson and Professor Edwin J. Houston, this patent being numbered 695,870. Both of these patents are owned by the Thomson-Houston Electric Company.

The invention set forth in Professor Thomson's patent referred to lies at the basis of the modern systems of distribution and relates to the use of transformers in multiple, and also such a system in which the secondaries of the transformers act to supply currents of a greater quantity and lower potential than those in the primaries to the consumption circuits in which lamps, motors or other devices are used.

The application for this patent was filed in 1885, and it has been involved in a series of hotly contested interferences between Professor Thomson and others who claim to have been the first inventors of this system of distribution, and by reason of the necessity of litigating this question in the Patent Office the patent could not issue until recently.

The scope of this Thomson invention will be understood from the claims of the patent, No. 698,156, which are as follows:

1. **In a system of electric distribution, a series of secondary circuits of induction coils supplying arc lights or other devices, the primary coils of which induction coils are multiple arc branches of a single primary circuit, or set of mains, A, B, through which alternating or reversed currents are flowing, as described.**

2. **In a system of electric distribution, a set of mains, A, B, supplied by alternating currents, or alternating electrical impulses, rendering said mains alternately positive and negative with respect to each other, in combination with branch circuits taken from said mains at convenient points, and finally carried through the primary wires or coils of a set or series of induction coils, the secondaries of which are connected to electric lamps, or other apparatus, for utilizing the impulses, generated in said secondaries by induction from the said primaries.**

3. **In a system of electric distribution, the combination with the high-potential mains through which alternating or reversed currents are flowing, of electric converters or reducers connected in multiple between said mains, and incandescent lamps or other translating devices supplied from said reducers with currents of lower tension and greater quantity than those circulating in the main circuit-coil of the converter.**

The other patent, namely, that to Professors Thomson and Houston, No. 695,-870, is for a system of alternating-current distribution in which the secondaries of transformers used for supplying the consumption circuits have a resistance as low as that of the primaries or lower than that of the consumption circuit.

The patent is not limited to using the transformers in multiple.

The character of the invention of this patent is indicated by the first and thirteenth claims, for instance, which claims are as follows:

1. **In a system of electric lighting the combination substantially as described, of an alternating-current circuit, an induction coil primary in said circuit, an induction coil secondary acted upon by said primary, and having an electrical resistance as low as that of the primary, and apparatus as described connected to said secondary.**

13. **As a part of a system of distribution of alternating currents, an inductorium the primary of which is fed from the main line and the secondary of which is in the consumption circuit and has a lower electrical resistance than the latter, substantially as described.**

The application for this patent was filed in 1887, but its issuance, until March of this year, was rendered impossible, by reason of the contest in the Patent Office over this invention, as was the case with that of the Thomson patent.

The inventions described in these two patents have been put into extensive use by the owners.

Special Train to the Electric Light Convention.

To the Editor of the Electrical Review:

Arrangements have been made to run a special train to Cincinnati for the convenience of members of the National Electric Light Association and their friends to attend the twenty-fifth convention, to be held in Cincinnati, May 20, 21 and 22.

This train will leave New York on Sunday, May 18, *via* the Baltimore & Ohio Railroad, foot of Liberty street, 10 A. M., foot of Whitehall street 9.55 A. M., arriving at Union Station, Cincinnati, directly opposite the Grand Hotel, headquarters of the association, at 8 A. M.

A rate of a fare and a third, on the certificate plan, has been granted by the various passenger associations. Fare to Cincinnati on this train will be $16; sleeping-car, double berth, $4; section, $8, and drawing-room, $14. Return railroad fare, when the certificate is properly endorsed, will be $5.35. For particulars, apply to Mr. Lyman McCarty, assistant general passenger agent B. & O. R. R., 434 Broadway, New York city.

Provided a sufficient number of passengers are secured for this train, a special dining car and a club car will be at the service of our people; it is therefore very important that those desiring accommodations on this train should make immediate application for space.

C. O. Baker, Jr.,
Master of Transportation.

The National Electric Light Association Convention.

The Trunk Line Association and Southeastern Passenger Association have confirmed the rate of a fare and one-third made by the Central Passenger Association for delegates attending the Cincinnati convention of the National Electric Light Association, to be held May 20, 21 and 22. A reception committee has been formed at Cincinnati, including prominent members of lighting and manufacturing companies, and is actively at work planning entertainment for the ladies attending the convention. A trolley ride to Rookwood Pottery has been arranged, a visit to the Museum of Fine Arts, a trolley trip through the city and suburbs to the Cincinnati Zoological Gardens, where a luncheon will be served. The Bullock Electric Manufacturing Company has arranged to take members by special train to and through its works.

The programme for the meeting will include, in addition to subjects announced, papers and discussions on "Boiler Firing with Oil," "Best Efficiencies for Incandescent Lamps," "Advantages of Gas Engines," "Signs and Decorative Lighting," "Steam Turbines," "Protection of Long-Distance Transmission Lines," "The 220-Volt Lamp." The question box already contains over twenty enquiries that will be answered, in addition to those answered by the papers, discussions and reports on the programme.

Northwestern Electric Association Convention.

The next convention of the Northwestern Electric Association will be held at Waupaca, Wis., commencing on Wednesday, June 18, 1902. A joint meeting of the Wisconsin Independent Telephone Association will also be held.

English Electrical Works to Start Up.

The plant of the British Westinghouse Electric Company, it is stated, is ready to begin operations. Mr. George Westinghouse, Jr., and H. S. Loud, general manager of the British company, are expected to be present at the starting up of the works.

A mixture of ten parts of white lead, three parts of black oxide of manganese and one part litharge will stop a small leak in a steam boiler in an emergency for a little while, but the leak itself is evidence of structural defect that needs radical treatment.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Anodes for Plating Irregular Objects.

The electroplating of objects of irregular form has always been difficult because the deposit tends to build up more rapidly on the points nearest the anodes in case the latter are flat. To produce anodes which shall be counterparts of the cathode in form is the object of a recent German patent granted to Herren Kugel and Steinweg. The anode is constructed of a hollow frame of glass or hard rubber or other suitable material cast to the shape desired, and filled with small perforations. The object to be plated is put into the bath, face up, and this anode is hung over it and filled with coatings or filings of the metal to be deposited. Strips of the same material are embedded in the filings to act as current connections, and as these are placed in the centre of the mass they are not very rapidly destroved. As the anode may be shaped very accurately to conform with the objects to be plated, it may be hung very near them in the bath, thus reducing the resistance of the latter considerably.—*Zeitschrift für Elektrochemie* (Berlin), February 20.

Electrical Depositions of Bright Metallic Coating.

A German patent has recently been granted to a Herr Darmstädler for improvements in methods of obtaining bright metallic coatings by electrolysis. Insoluble materials such as sawdust, fine sand, powdered pumice stone or similar things are added to the solution, or the salt composing the electrolyte itself may be added in a fine state of subdivision to the saturated solution, and the battery is kept by mechanical means in constant agitation. The effect of the finely divided insoluble matter held in suspension in the liquid is to loosen any bubbles of hydrogen clinging to the surface of the cathode, and also to act mechanically as a burnisher upon the latter. It is stated that the production of bright metallic deposits is greatly aided by the use of this method. Some hope has been held out that the method may also be of use in securing successful electrolytic zinc deposits. If spongy zinc deposits are due to the presence of basic zinc salts, as many believe, then this method is not likely to be of much service. Where the spongy character of the deposit, however, is due to the separation of the hydrogen simultaneously with the zinc and the adherence of small bubbles of this gas to the surface of the metal, it is likely that the method suggested will be of considerable value.—*Zeitschrift für Elektrochemie* (Berlin), February 13.

An Ultra-Violet Electric Lamp.

An extremely ingenious lamp for the production of ultra-violet radiations has been designed by Mr. Leslie Miller in conjunction with some of the medical staff of St. Bartholomew's Hospital in London. The ultra-violet rays are used in the treatment of lupus and other skin diseases. The appliance consists of a small step-up transformer raising the pressure to about 6,000 volts and charging a condenser contained in a box filled with oil. The condenser discharges across a spark-gap fitted with iron points about one-eighth inch apart. The lamp is simply a metal tube with an enlarged end in which the arc is struck between the iron points. An ordinary induction coil giving a spark from six inches upward may be used instead of the transformer. As the impedance in the condenser circuit is simply that due to the short flexible connections of the lamp, the oscillating discharge of the condenser is extremely rapid and an abundance of ultra-violet rays is given off, together with a small amount of visible light. It is stated that the iron points are practically indestructible. In a room lighted by diffused daylight many substances show wonderfully brilliant fluorescence when held one or two feet away from this arc. The energy consumption is only about twenty watts at the arc.—*Electrician* (London), April 11.

Tests of the Nernst Lamp.

A valuable paper was read before the Birmingham local section of the Institution of Electrical Engineers recently by Mr. R. P. Hulse, upon tests made upon commercial Nernst lamps. The only lamps dealt with are those of 100-watt capacity for direct 110-volt current. To sum up Mr. Hulse's conclusions, the life of the lamp is from 300 to 400 hours during which its average efficiency is about two watts per candle-power, the initial efficiency being about 1.7 watts per candle-power. A careful study of maintenance and replacement costs shows that the ratio of expense for the production of light from Nernst and incandescent lamps is as eleven to fifteen with current at eight cents per kilowatt-hour. The candle-power of the lamps falls off considerably during their lifetime. At the end of 350 hours of burning they show only half the initial candle-power, which is a greater falling off than is exhibited by ordinary incandescent lamps. On the other hand, the current passing through the lamp falls off also quite rapidly and the efficiency does not decrease in anything like the measure exhibited by the incandescent lamp. It is suggested that the iron-wire resistance in the lamp might be replaced after, say, 150 hours' burning with a smaller one, so that the lamp would then maintain a fairly high candle-power during the latter part of its life also without much impairment of its efficiency.—*Electrician* (London), April 4.

The Ventilation of the Simplon Tunnel.

The ventilating plant used in the Simplon tunnel, which is a new railway tunnel now under construction under the Simplon Pass, between Switzerland and Italy, is of much interest. At each end of the tunnel are two fans, each of which is twelve feet four inches in diameter. There is a suction opening on each side nearly five feet in diameter, and each fan is directly coupled to a direct-current motor of 200 horse-power running at 400 revolutions per minute. The fans deliver 883 cubic feet of air per second against a pressure of ten inches of water. This plant will be used for the ventilation of the tunnel in operation as well as during the period of construction. Either fan can be worked separately and can be used either to force air into the tunnel or to suck it out, suitable doors and shutters being provided to connect the openings into the tunnel with either the suction or delivery passages of the fans. The two fans at either end may be worked simultaneously or the two may be set up tandem with the suction of one coupled to the delivery tube of the second. The ventilation obtained is excellent, and it is possible to take sights with the transit

from the tunnel portal to the working face, a distance of 16,400 feet at present. Auxiliary fans driven by Pelton water-wheels are used in the tunnel headings, water being brought to them at a pressure of 1,200 pounds to the square inch.—*Schweizerische Bauzeitung* (Zurich), March.

Telephone Listening-In Indicator.

A simple and interesting apparatus has been tried experimentally on the lines of the government telephone exchange at Stockholm, Sweden, for the last year. Its object is to indicate to the subscriber whether or not the central station operator is listening to his conversation. Bridged across the subscriber's line and connected to it by a double-pole switch is a current detector whose middle point is earthed. The central point of the operator's receiver is also earthed through the busy test battery in the ordinary manner. When the operator switches in her telephone through her listening key a current is sent over both lines in parallel through the subscriber's indicator mentioned above and to earth, and the telephone subscriber knows that the operator is on the line. The indicator itself has a pair of astatic needles upon the axis of which is placed a light disc with black, white and red crosses painted upon it. The disc moves behind a shutter so that red or white shows that the operator is listening. In this way when the communication is through two exchanges the connections can be so arranged that a white cross indicates that the operator at one exchange is listening and a red cross that the operator at the other end is in circuit. It is stated that the apparatus works well and is popular among the telephone subscribers. If this be the case, telephone subscribers in Stockholm must have more time than those in most American cities. In this country the difficulty of operators listening in is overcome by the fact that at most exchanges they are too busy, and in some it is impossible for them to listen in at all.—*Elektrotechnische Zeitschrift* (Berlin), April 3.

The Action of Sea Water on Cement.

At the recent congress upon the testing of materials of construction which assembled at Budapest, M. Le Chatelier contributed an important paper upon the action of sea water upon Portland cement. It appears from this that the aluminum compounds are the constituent of cement more subject to attack by sea water. The decomposition arises from the action of calcium sulphate upon the calcium aluminate of the cement, the calcium sulphate being produced by a reaction between the lime of the mortar and the magnesium sulphate held in solution in the sea water. The resulting compound formed is a sulpho-aluminate of lime which swells considerably, thus causing the disintegration of the mortar. The greater the quantity of alumina present, the greater naturally is this action. With cements containing only one to two per cent of alumina it is slight and often can not be detected. With cements containing seven to eight per cent of alumina the mass is rapidly destroyed. Substitutes for alumina which were tested by M. Le Chatelier consisted of oxides of iron, cobalt, chromium and magnesium. The cements were prepared by mixing the ingredients, heating them to the temperature of fusion, and then grinding the mass produced. The stability of these cements in the presence of calcium sulphate was much superior to that of those containing alumina, the best results being had when iron oxide was the substitute used. This cement was found to have very excellent mechanical properties also.—*Engineering* (London), April 11.

A New System of Rail Bonding.

A new system of rail bonding has been invented and applied in Austria, which seems to possess some curious advantages. The method of bonding consists of applying a powerful binding casting to the ends of adjacent rails, the mechanism employed consisting of three pieces of cast steel, one in the form of a chair upon which the rail ends bear and the other two forming parts of a wedge system which may be driven up tightly so as to hold the rail ends in place. The larger piece, or chair, embraces one side of the rail flange and extends under the base of the rail to the opposite side, where is formed a projection upon which bears the wedge system used for locking the ends. Another piece embraces the opposite flange, and between these two a keying wedge is applied. The base plate or chair is heated red hot in a portable furnace and a sheet of plate zinc is laid upon it, on the part which the base of the rail rests upon. The rail ends are thoroughly cleaned by emery or sand blast, and when the jointing castings are put on the heat melts the zinc and forms a film contact which is said to be very good, electrically speaking, between the two ends. The wedge is driven up as tightly as possible while the chair-piece is hot, and when the latter cools and contracts a powerful pressure is brought to bear upon the rail ends and the film of zinc between the castings, and these ends form what is claimed to be a mechanically and electrically excellent joint. The system has been introduced upon various German electric railways, upon grades and curves, and is stated to have shown excellent results. It is stated that the castings for the average rail weigh from thirty-six to sixty pounds and that the joints cost in place from $3 to $4.40 each. The various castings are made of steel, the wedge being of open-hearth steel of great strength.—*L'Electricien* (Paris), April 5.

Cable Insulation.

At a recent meeting of the Société Internationale des Électriciens, M. Hall Charpientier contributed a long and valuable paper on cable insulation. He considered first the total actual loss of energy through the insulating sheaf of the cable, and second, the safety and durability of the cable. His opinion is that the resistance value of cable insulation should be based upon the first consideration so far as it may be consistent with the requirements of the second. Such a system, he concluded, would lead to a considerable reduction in insulation resistance and a consequent proportionate reduction in price. Taking a specific instance of a 1,000-kilowatt station feeding a 525-volt network 120 kilometres in total length, and allowing a loss of energy through the cable insulation equal to one one-thousandth of the total output, the insulation figures out from 60,000 to 100,000 ohms per kilometre, a figure some 5,000 or 6,000 ohms less than the average guarantee. The modification of usual practice suggested by this consideration the author believes to be entirely consistent with the safety and durability of the cable. He considers that the best method of measuring insulated resistance is the direct-deflection method, but he believes that the ordinary two minutes' application is too short, as during this time the capacity current still superposes itself upon the conductivity current. Readings, he thought, should not be taken before five minutes and sometimes even ten minutes. A letter from M. Picou, who was chief electrical engineer of the recent Paris Exposition, agrees that insulation resistances ordinarily specified are much too high. He thought that in addition to the usual high-pressure tests at twice the working pressure tests of insulation resistance should be made simply to see that the cable is fairly homogeneous in quality.—*Bulletin Société Internationale des Electriciens* (Paris), March.

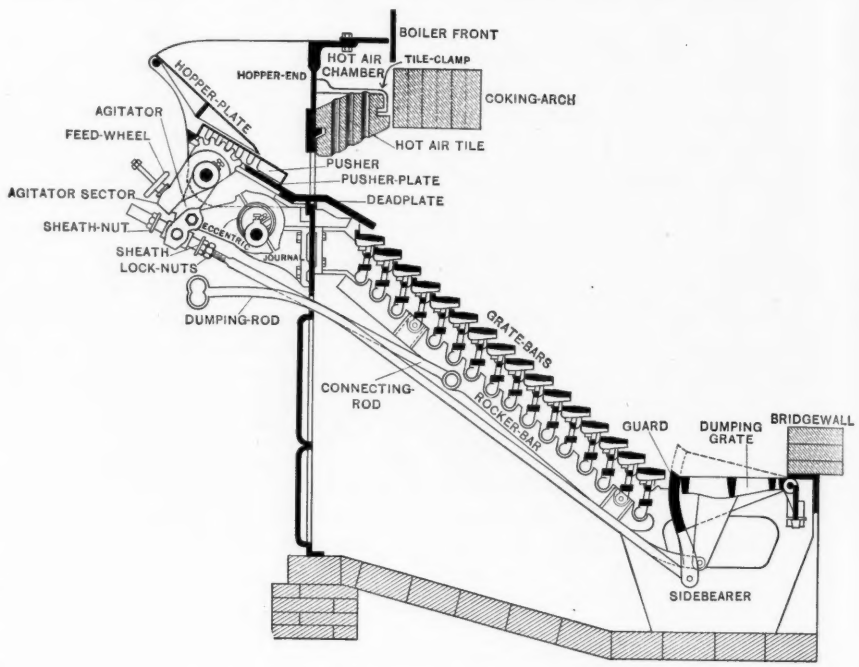
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

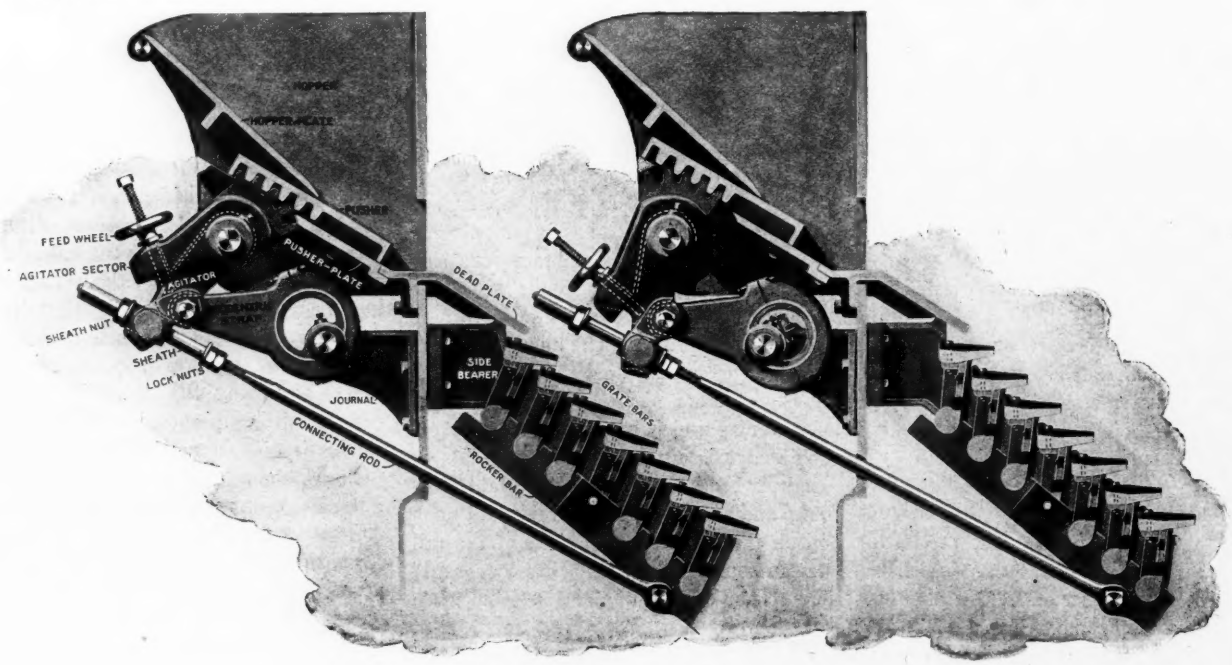
The Mechanical Stoking Equipment of a Large Electric Power Plant.

The entire system of the Metropolitan Street Railway Company, New York city, presents a most interesting study for engineers and managers of large power plants and street railway properties. The steam plant contains eighty boilers arranged in three tiers, 200 by 166 feet each. They are of the Babcock & Wilcox water-tube type with 126 four-inch tubes, eighty feet long, and two forty-two-inch drums, nine-sixteenths of an inch thick, twenty-three feet three and five-eighths inches long. The boilers are built to carry 200 pounds, but at the pressure adopted for the station—160 pounds—they will have a rated capacity of 250 horse-power, although they can develop 400 horse-power. These boilers were equipped with Roney mechanical stokers by Westinghouse, Church, Kerr & Company, New York city, and although there are now in course of construction in New York other plants which, when completed, will have a larger capacity, this plant has the distinction of having the largest installation of mechanical stokers in the world in actual operation to-day. The Manhattan railway with its ultimate equipment, 384 stokers, attached to ninety-six boilers of 50,400 horse-power; the plant at the New York Edison Waterside Station, which will have 224 stokers, and the Third Avenue Street Railway plant of the Metropolitan company, which will have 240 stokers of this same design, will shortly be in complete use.

This mechanical stoking apparatus is a development of many years of experiment and investigation, and during the last eighteen years it has been in practical commercial operation, and for at least ten years has been generally adopted in the

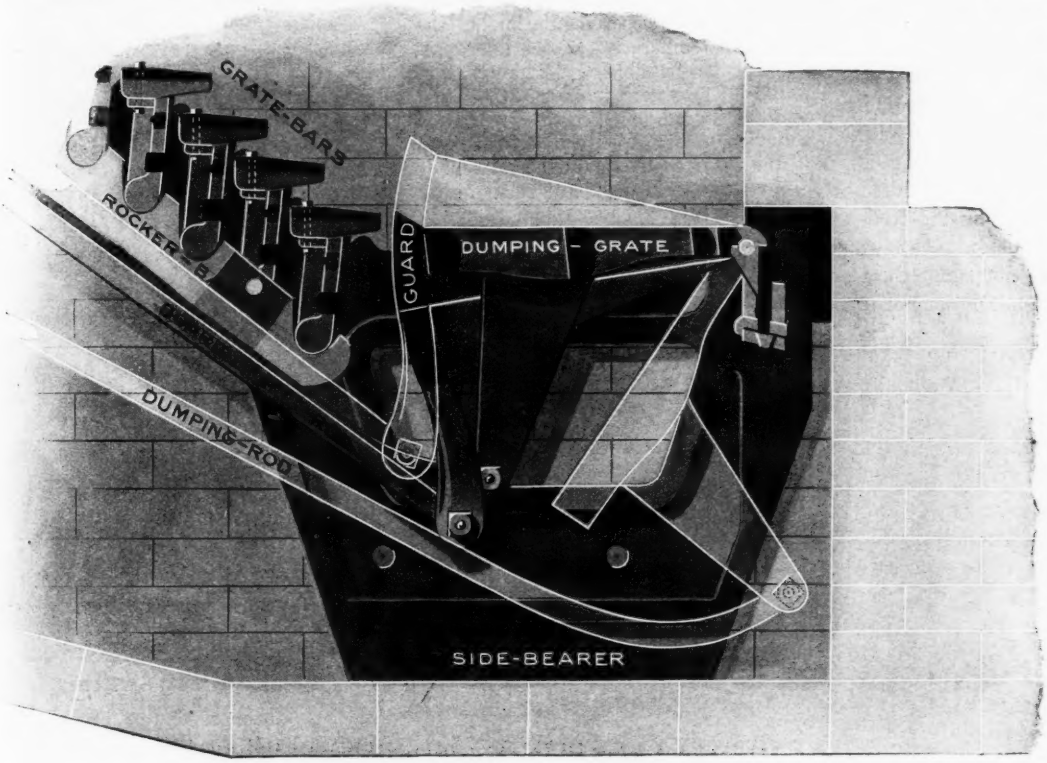


DIAGRAMMATIC ILLUSTRATION OF MECHANICAL STOKER.



ENLARGED SECTION SHOWING DETAILS OF FEEDING MOVEMENTS.

larger and more improved steam plants throughout the country. Many changes and modifications have been introduced since the stoker was originally designed, and numerous improvements have been devised to meet the requirements of the heavy work that has lately been undertaken in all branches of power service.

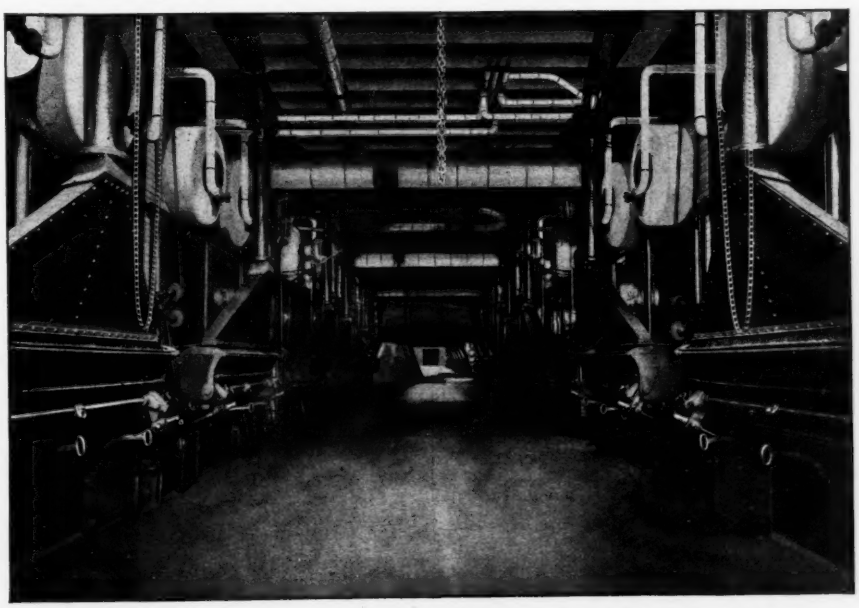


SECTION SHOWING DETAILS OF DUMPING GRATE AND GUARD MOVEMENT.

The details of construction of the latest form of Roney mechanical stoker are shown in the accompanying diagrammatic illustration. The equipment consists of a hopper for receiving the coal, a set of rocking, stepped grate bars, included at an angle of thirty-seven degrees from the horizontal, and a dumping grate at the bottom of the incline for receiving and discharging the ash and clinker. The dumping grate is divided into several parts for convenience in handling.

Coal is fed to the inclined grate from the hopper by a reciprocating pusher, which is actuated by the agitator and agitator sector. The grate bars rock through an arc of fifteen degrees assuming alternately the inclined position and the stepped position illustrated in the engravings, showing details of feed and grate movements. The grate bars receive their motion from the rocker bar and connecting rod, and these, with the pusher, are also actuated by the agitator, which receives its motion through the eccentric from a shaft attached to the stoker front, under the hopper. The range of motion of the pusher is regulated by the feed-wheel from no stroke to full stroke, and the amount of coal pushed into the furnace may therefore be adjusted according to the demand for steam. The motion of the grate bars is similarly regulated and controlled by the position of the sheath nut and lock nuts on the connecting rod. Each grate bar is composed of two parts, a vertical web provided with trunnions at each end, which rest in seats in the side-bearers, and a fuel plate, ribbed on its under side, which bolts to the web. These fuel plates carry the bed of burning coal, and, being wearing parts, are made detachable, thus reducing the cost of repairs to a minimum. The webs are perforated with longitudinal slots to disclose the condition of the fire at all times without opening the doors. Free access may be had to all parts of the grate to assist, when necessary, the removal of clinker. These slots also serve an important purpose in furnishing an abundant supply of air for combustion.

Anthracite coal is burned under half of the boilers in the Metropolitan plant. The stokers are fitted with what is termed a guard, which may be raised to prevent the small anthracite coal from sliding when the dumping grate is dropped to discharge the accumulated ash and clinker. On restoring the dumping grate to its normal position the guard is dropped.



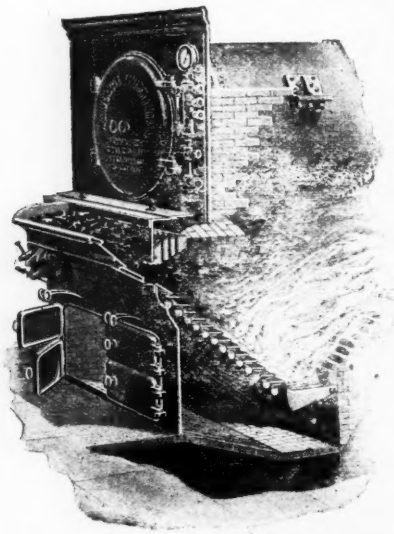
A TIER OF BOILERS IN METROPOLITAN STREET RAILWAY PLANT EQUIPPED WITH MECHANICAL STOKERS.

The design and construction of the dumping grate and guard are clearly

shown in the detailed illustration of this feature.

An excellent view of one tier of the boilers equipped with Roney stokers in the Metropolitan company's station is shown in the half-tone reproduction. The experience of the company with these stokers has been very satisfactory. The saving in labor has been a considerable item, and the improvement in the service over the old standard of hand-firing is very noticeable. The supply of coal fed to the furnace is regulated by the feed-wheel and the motion of the grate bars by the position of the lock nuts, and these adjustments are easily made by any fireman.

These stokers are operated by small four by four and one-half Westinghouse



SECTION SHOWING MECHANICAL STOKER WITH HORIZONTAL BOILER.

engines, made of special design for this service. Their construction is excellent for boiler-house use, being of enclosed type with all moving parts entirely protected from dust and dirt. The engines run in a bath of oil, as do the worm and worm-gear to which the engine is direct-connected, and the worm-gear housing, which is completely enclosed, is attached direct to the engine frame and housing, making a complete and simple construction. The lubrication is entirely automatic. The operation and adjustment require little skill, and, it is claimed, can be successfully taken care of by the ordinary fireman. In this particular plant each floor in the boiler house is divided into four sections. One engine is sufficient to run a section, but a relay is installed as a safeguard against possible accident to driving gear of shafting.

In operation the entire bed of fire is visible from the underside of the grate, as shown in the cut of the Roney stoker attached to a horizontal boiler. Clinkers can be seen as they form and may be dislodged without opening the doors. If the fire should burn unevenly, it can be detected instantly and corrected without trouble.

Mr. M. G. Starrett, chief engineer of the Metropolitan Street Railway Company, has made a statement that with mechanical stokers throughout it is possible to insist on closer regulations of the quality and temperature of the flue gases than will be possible with hand-firing. The rate of feeding, thickness of coal and amount of air admitted to the fire are all practically under the control of the stoker. The flue gas in each case during tests made for analysis at the company's laboratory showed nearly perfect combustion.

A New Desk Set and Residence and Hotel Telephone.

In the accompanying illustrations is shown a new design of a common battery telephone and a new common battery magneto desk which has lately been brought out by the Eureka Electric Telephone Company, of Chicago, Ill. The design in Fig. 1 is of the popular standard type for this class of work, but in the box some special features have been arranged, especially the method of connecting the transmitter support and in employing with this a new idea in the receiver. The condenser box is worked

NEW COMMON BATTERY INSTRUMENT.

out in an excellent manner in the rear of the instrument, this being furnished with all the common battery systems of the company, according to the desires of the customers. In places where a small instrument is wanted, where there is no space to put a regular common battery, the company claims that it is a very desirable instrument.

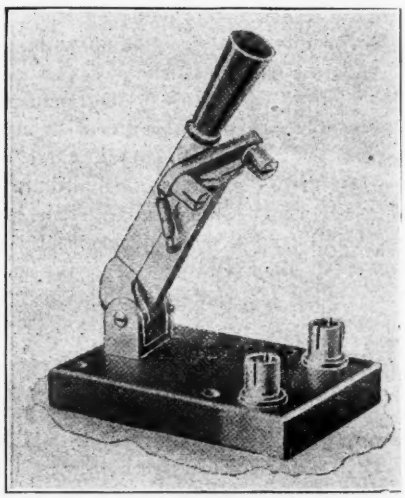
Fig. 2 shows a new common battery magneto desk set brought out by the same company. The base and upright are of solid brass casting, put into a lathe and engine-turned, and it is claimed that it will suffer no damage by being thrown by accident from its position on the desk. This desk set is mounted with the regular special receiver, all hard rubber case and solid back, special diamond-grained carbon transmitter, which, the maker claims, is especially adaptable to long line work and common battery work. These instruments are furnished for both com-

NEW COMMON BATTERY DESK SET.

mon battery and magneto work with the other usual parts to complete the sets according to requirements.

Quick-Break Switch.

A neat form of double break switch, patented by Messrs. Broadbent & Brooke and made by T. W. Broadbent, Huddersfield, England, has been described and illustrated in the *Electrical Review*, London. The special feature, apparently, is



QUICK-BREAK PLUG SWITCH.

the good contact which it is claimed is secured by the split plugs and sockets. The former are slightly tapered to cause the socket to expand and grip the plugs. In case of injury to the working parts by breaking an excessive current, it can be renewed in a very short time. Single and double-pole and change-over switches are also made in this form in sizes from 50 to 500 amperes.

American Railroads and Progress.

Mr. George H. Daniels, the general passenger agent of the New York Central & Hudson River Railroad Company, in the course of an address in New York recently on railroads and their relation to other industries elaborated on the use to which American product of every description was being put in foreign countries, particularly in Great Britain. He seemed to find that almost every condition of living was largely entered into by material made in the United States. He said that an Englishman on reaching his office, if it be fitted up in a modern manner, sits on a Nebraskan swivel chair, before a roll-top desk made in Buffalo; his letters are written on a Syracuse typewriter, he signs them with a New York fountain pen and dries them on a blotting sheet from New England, then the letter copies are put away in files manufactured in Grand Rapids. His traveling he does in a car built in New York, propelled by electrical machinery manufactured in the United States over a railway constructed by American engineers and largely of American material.

Mr. Daniels gave to the railroads much of the credit of the great prosperity of the country during the last half dozen years. Citing an example of the reasons why the railroads have transcended canals he told of a record-breaking exploit of very recent date. A boat loaded with grain from the West reached Buffalo on a Saturday afternoon, while the Cedric of the White Star Line waited at her pier in New York city about to sail with water for ballast unless she could get the cargo of grain. The grain that reached Buffalo on the Saturday afternoon was in the hold of the Cedric on the following Monday afternoon. Mr. Daniels stated that this record had never been equaled.

Proposals for an electric power pump for the Montreal waterworks will be received up to noon on Tuesday, May 6, at the office of the city clerk, City Hall, Montreal, for the erection at the high-level station of a five million imperial gallon pumping engine to be driven by electricity against a pressure of twenty-six pounds per square inch.

Electrical Exhibit at the Charleston Exposition.

The General Electric Company has a splendid exhibit at the Charleston Exposition, occupying the centre of the Electricity and Machinery Building.

The operating part of this exhibit represents a typical modern rotary converter substation. It contains a 500-kilowatt rotary converter running on a 2,300-volt 60-cycle circuit and furnishing 500-volt currents for motors used by the Exposition company in different parts of the grounds. This installation consists of three 185-kilowatt air-blast transformers, the air being furnished by a standard blower operated by one of the company's induction motors. One of the company's standard railway switchboards is installed. It is of handsomely enameled slate and consists of six panels, four of them controlling feeder circuits. This converter is so connected that during the rush hours 500-volt current is supplied to the Charleston Consolidated Railway, Gas and Electric Company's feeders for the lines running to the exposition. The company has aimed in its Charleston exhibit to show such apparatus as is particularly interesting to people of that section and to a certain extent typical of its business in the South. Two types of induction motors are shown, both representing the company's work in cotton mills. The Anderson Cotton Mills, at Anderson, S. C., use a peculiar design of induction motor known as the water-cooled, a type which is of considerable interest to engineers visiting this exhibit. For general use, however, a standard type of induction motor furnished with two pulleys at each end of the shaft is preferred. A sixty-five-horse-power motor of this type is shown mounted upon a frame. It is fitted with a hand-starting lever and embodies all of the latest features recognized as essential to successful operation in the class of work for which it was designed. There are several small machines direct-connected to General Electric motors, notably a coffee-grinder and a meat-chopper of patterns extensively used. Two standard railway motors with one of the well-known type "K" controllers are exhibited, one of the motors being thrown open to facilitate inspection by visitors.

An Electrical Exhibit at the Charleston Exposition.

A complete line of the company's arc lamps is shown, most of them being in actual operation and provided with densely colored enclosing globes and glass casings, a combination which permits free examination of the mechanism and a close inspection of the arc without danger to the eyes. The Electricity and Machinery Building is lighted by means of General Electric series alternating system, as are also the grounds of the exposition and the interior of the auditorium and several

other buildings. Transformers operating this system about the grounds are located in the exposition substation in the auditorium. A set of blue Vermont marble panels is shown with a full line of General Electric instruments, switches and other switchboard devices mounted on them.

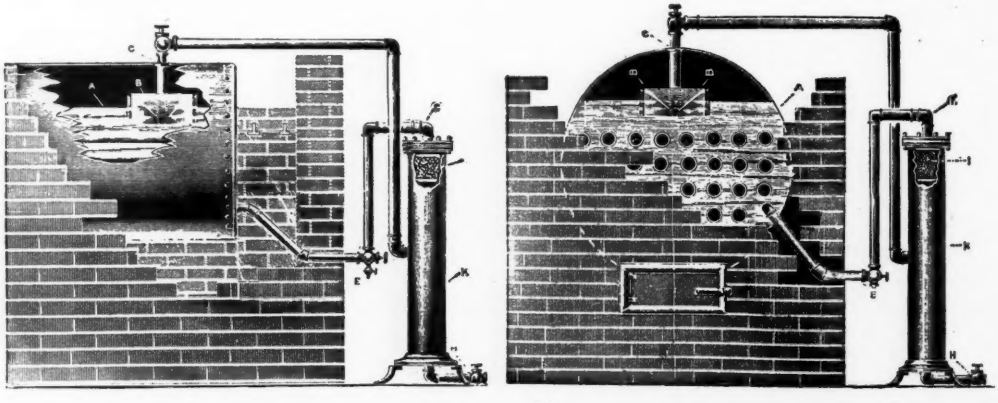
One of the most interesting still exhibits at the exposition is the company's model of its factories at Schenectady, N. Y.; Lynn, Mass., and Harrison, N. J., which is placed directly opposite the main entrance on the company's space in Electricity Building. It is surrounded by artistically grouped photographs and display stands of the company's small wiring devices and supplies.

An Improved Filter Boiler Cleaner.

The problem of ridding the steam boiler of the scale and incrustation which are inherent in the use of water derived in almost any section of the country is one that is engaging the serious thought and effort of inventors and manufacturers. Scale is, above all, a non-conductor, it having been stated as results of tests which have been made that a scale of one-eighth of an inch thickness requires nearly thirteen per cent more fuel to produce the same results as are obtained with a clean boiler, while one-quarter of an inch of scale—this is a remarkably bad condition—requires much more than a proportionate increase in fuel to produce fairly good results.

The Sims improved filter boiler cleaner manufactured by the Sims Company, Erie, Pa., two views of which are shown in the accompanying illustrations, is claimed by the maker to be a simple mechanical device which embodies excellent features which make it a reliable and efficient apparatus for keeping a boiler clean.

The cleaner is provided with funnels or skimmers of such size as to cover a large surface of water; these are suspended near the rear of the boiler with the openings toward the front, rear and sides, the average water line being in the centre of the skimmers. The impurities gathering from all directions to this point, but chiefly from the forward part of the boiler, float into these skimmers. The circulation of water through these skimmers is produced by returning the water to the boiler through a pipe exposed to the heat of the rear arch, drawing off the impurities into a precipitator. The water in this precipitator from the point of inlet to the bottom being left at rest, the impurities floating into this cool, quiet body of water and have a tendency to settle. The result is that the scale-producing matter is being constantly removed. The manufacturer then claims that as soon as the new formation ceases the expansion and contraction of the boiler will cause the breaking off of the old scale which will be removed in the manner above described, making it a question of time when the boiler can be kept in a clean condition.



An Improved Filter Boiler Cleaner, Showing Front and Rear Connections.

Consul-General Seeger, writing from Rio de Janeiro, Brazil, states that among other things electrical sugar machines of every kind, including cane-crushers and dynamos and motors of various types and dimensions, are greatly in demand for new installations of machinery which are being made in these parts. A syndicate composed of Dutch capitalists, Messrs. Von der Ben and F. W. Bolk, of Stork Freres, Hengelo, Holland, are those particularly interested. The same gentlemen are desirous of securing the sole agency for American rails for narrow-gauge roads from twenty-nine and one-half to forty inches in width, and for locomotives and other rolling stock to be used in the transportation of sugar over such roads.

Aluminum-Zinc Alloys.

The strength and hardness of aluminum-zinc alloys decrease rapidly with less than twenty per cent of zinc, and the alloy can be forged, rolled or drawn when the amount of zinc is fifteen per cent or less. Castings made from the alloy with fifteen per cent of zinc show an elastic limit of 16,000 pounds per square inch, tensile strength 22,330 pounds, elongation in two inches six per cent, and reduction of area sixteen and one-half per cent.

"A Very Attractive and Instructive Number."

[*From Nature, London.*]

Our contemporary, the *Electrical Review,* of New York, celebrated on February 15 the twentieth anniversary of its publication. The greater part of a special issue is devoted to retrospective articles on the development of the different branches of the industry during the past twenty years. In 1882 the incandescent lamp was only just developed to a practical article; toward the end of the year the first central generating station was opened by Mr. Edison in New York. The first attempts at electric traction were just being made, and industrial electrochemistry had not advanced further than electroplating and a little copper refining. It has become, perhaps, hackneyed, to remark on the rapid development of electrical engineering, but it is pleasant to be reminded occasionally in so striking a fashion how very great the rapidity has been.

One of the most interesting features of the issue under consideration is the reproduction of engravings from early numbers showing some of the first commercial machines, and the comparison of these with the process blocks of the enormous engines and dynamos now in use.

Altogether we can congratulate the paper on a very attractive and instructive number.

A Progressive Publication.

[*From the Editor and Publisher.*]

In the celebration of its nineteenth anniversary, the ELECTRICAL REVIEW published on February 15 an elegant number of 170 pages, 100 of which were devoted to advertising. The ELECTRICAL REVIEW is one of the most progressive and thoroughly interesting trade publications in the United States.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

ANOTHER TUNNEL—A company bearing the name of the Pennsylvania, New York, Long Island Railroad Company has been formed at Albany, with a capitalization of $20,000,000, to build the Pennsylvania's East River tunnel. The tunnel is to be five miles long, and is to run from a point under the Hudson river at the boundary line between the states of New York and New Jersey, under the East River and to a point under the Long Island Railroad in Long Island City.

ELECTRIC LIGHT FOR MALAYS—The palace of the Sultan of Linga, a small island in the Malay Archipelago, is to be equipped with an electric lighting plant manufactured in the United States, two New York firms furnishing the equipment. Iloilo in the Philippine Islands is also to have an up-to-date American electrical plant for railway and lighting use, an electric railway system being constructed between Iloilo, Jaro and Molo. The road will be about ten miles long and is expected to open up a rich district.

A NEW IDEA IN TROLLEY CARS—A new open car for the elevated service of the Coney Island lines of the Brooklyn Rapid Transit Company is shortly to be put in operation. The car is designed to accommodate the summer traffic and is equipped with sidesteps that fold up and wire gates which are operated by the conductor from one end of the car. This will bring the carrier within the law concerning the safety of the public. Much time has been spent in perfecting the appliance for the new car and if it proves to be the success anticipated, all the elevated systems will be equipped with this form of car.

THE WIRELESS TELEGRAPH COMPANY—The Marconi Wireless Telegraph Company of America has been duly incorporated and the capital stock is now being subscribed for. This is placed at $6,650,000. Of the total capitalization, $500,000 is retained in the treasury of the company for future requirements. The company controls the Marconi system of wireless telegraphy in the United States, Cuba, Port Rico, the Hawaiian Islands, the Philippine Islands, Alaska, the Aleutian Islands and all ships under the American flag. The directors of the company are: G. Marconi, ex-Attorney-General John W. Griggs, Samuel Insull, Commander J. D. J. Kelley, Eugene H. Lewis, H. H. McClure, Wyllis Rossiter Betts, Colonel John J. McCook, E. Rollins Morse, Cyrus J. Sedgwick, Loyal L. Smith and Spencer Trask.

A LARGE SOUTHERN ELECTRIC PROPERTY DEAL—A deal has been made at the offices of the International Trust Company in Baltimore for the purchase of three important southern properties, and this apparently is the preliminary to a consolidation of street railways and kindred interests of considerable extent in the South. The aggregate properties to be united are estimated to be worth from $20,000,000 to $25,000,000. The following companies are involved: The Virginia Electrical Railway and Development Company, with a capital of $1,000,000; Westhampton Park Railway Company, $300,000, both of Richmond, Va. This consolidation embraces all the street railways of Richmond, Manchester, Petersborough, and the interurban connecting lines, all the electric light and power business in the same places, the water rights of the James and Appomattox rivers, and large holdings of real estate including sites for manufactories.

CANADIAN APPLICATION OF MOTORS FOR INDUSTRIAL PURPOSE—The first cement plant in Canada to be operated by electric power is that of the National Portland Cement Company at Durham, Ontario. All of the cement-making machinery in this plant will be driven by induction motors supplied with current by two Westinghouse 450-kilowatt three-phase alternators. These machines are of the engine type with revolving fields and run at 125 revolutions per minute, 3,000 alternations and 600 volts. Two exciting units are provided, one consisting of a 62½-kilowatt, 125-volt, engine-type, direct-current generator, direct-connected to an automatic engine, and the other of a 56½-kilowatt machine coupled to an induction motor. The output of the exciters will be used not only for exciting the fields of the alternating-current generators, but also for arc and incandescent lighting throughout the works and grounds. The Westinghouse company also furnishes the eight-panel switchboard and instruments.

WIRELESS TELEGRAPH TESTS—It has been announced that experiments have been conducted by the United States Weather Bureau, under authority of the Secretary of Agriculture, which have been more successful than any carried out heretofore. The experiments were made from Cape Hatteras to Roanoke Island, a distance of fifty-one miles, by an entire salt-water route. Professor Moore, the superintendent of the Weather Bureau, who has had the experiments in charge, states that they have demonstrated the feasibility and practicability of sending wireless telegraph messages at sea and as quickly and accurately as overland wires. Much of the credit is stated by the experimenters to be due to a new wireless receiver using a telephone instrument. It has been decided to have a test of the various wireless systems in the naval service, and instruments are now being purchased abroad by American naval attaches. The tests will probably be made over a land route between the Washington Navy Yard and the Naval Academy at Annapolis.

TELEPHONE AND TELEGRAPH

BUFFALO, N. Y.—The Hamburg Telephone Company, the local corporation, will endeavor to get its line into Buffalo this season, in connection with the new Frontier Telephone Company, of Buffalo.

TUNKHANNOCK, PA.—The Wyoming Telephone Company has gone into new hands, and the present owners intend to put the concern in better shape, and to extend the lines to other points during the coming season. The directors are projecting a meeting at an early date to look over the field and plan new improvements.

HONEOYE, N. Y.—The People's Telephone Company has secured the right of way and will build a line to Canadice at once. Part of the equipment is already on the ground and contracts have been made for a number of connections. The company has also made arrangements to connect with the Spring Water local line at Canadice.

GRAYVILLE, ILL.—The Independent Telephone Company is rapidly making connections through its exchange in the city and the surrounding country. The manager, W. F. Westfall, contemplates putting in a new switchboard of 200 lines capacity in the near future. A line is now being extended to Crossville and will shortly be in operation.

CHICAGO, ILL.—It has been stated that telephones will supplant the telegraph lines for practically all of the commercial business of the Burlington Railroad within a short time. Wires are now being strung connecting the principal division points of the system and as soon as the lines are finished all communications between the officers and all directions, with the possible exception of train orders, will be thus transmitted.

DUBUQUE, IOWA—The Dubuque Telephone Company is pushing the work on its extensions north and west of this city. Three carloads of poles have arrived for the Earlington branch to the north where a large force of men is kept at work. It is expected that in a few weeks almost every town and village in Clayton County will be connected, along with many farm residences in Dubuque County. The work on the new lines of this company from Dyersville and Earlville toward the northwest is also proceeding very rapidly, as is also the line to Delhi in the southern part of Delaware County.

ELLICOTT CITY, MD.—The lines of the Boyds Telephone Company have been turned over to a new syndicate from Hanover and McSherrytown, Pa., which has recently purchased all the telephone lines in Montgomery, Frederick, Carroll, Washington, one or two in Howard County, and a number of lines in Pennsylvania and the Virginias. It is the intention of the new syndicate to expend next month on the Boyds Telephone line from $8,000 to $10,000 in rebuilding lines and putting up metallic circuits. A number of new long-distance telephones and copper trunk lines will also be incorporated, and the work on these improvements will be commenced at once. Connections will be made immediately with Frederick, Westminster and Baltimore companies, thereby gaining direct connections with Baltimore and Washington. It is reported that the new syndicate is also endeavoring to obtain control of the Gaithersburg telephone lines, which run from the lower section of Montgomery County.

ELECTRIC RAILWAYS

ROME, N. Y.—Six weeks is the time given by the managers as that which will be required to build the extension to the Utica Suburban Street Railway Company's line from Oriskany to Rome, and place their cars fairly in operation on an established running time schedule.

COLUMBUS, OHIO—The Columbus Railway Company has awarded the contract for an 1,800-horse-power engine and generator and a traveling steel crane, increasing the capacity of the plant nearly one-half. This, with other changes which are contemplated, will involve an expenditure of about $100,000.

PHILADELPHIA, PA.—The charters granted by the state to the Pennsylvania Railway Company to build an underground railroad on Market street and Broad street will be surrendered, it is announced, and the railroad company will give to the Mack-Union Traction Syndicate free rein to build a subway on either street.

EASTON, PA.—At a recent stockholders' meeting of the Lehigh Valley Traction Company it was decided to issue $500,000 of preferred seven per cent stock to make improvements and extend the lines. The power-house in Allentown will be rebuilt, new machinery will be purchased, and the capacity of the plant will be more than doubled.

GREENSBURG, PA.—The contract has been let for the building of the Apollo, Vandergrift & Leechburg Electric Street Railway, which has to be completed by July 1. The road will extend from Apollo to Leechburg, thence to Hyde Park, through to Braeburn, where it will connect with the Tarentum traction system. A line to New Kensington is also contemplated.

VALDOSTA, GA.—The engineering corps of the Atlantic, Valdosta & Western Railway has begun the work of locating the route for the extension of the route from this city to Albany. There will be considerable change in the route as surveyed a year or more ago and when completed the building of the road will be pushed with all possible despatch as far as Moultrie.

WILKENSBURG, PA.—The Wilkensburg & Verona Street Railway Company has begun pushing the work of building its line to the upper end of Oakmont borough. The power-house which is in course of construction at Sandy Creek, four miles from Wilkensburg, will be completed as soon as possible and will begin immediately to operate that much of the route.

BUFFALO, N. Y.—An electric road between St. Catharines and Hamilton, it is announced, will be built so that direct connection by trolley between Buffalo and Hamilton, Ontario, a distance of 100 miles is now a matter of only a few months. The Niagara Falls, St. Catharines & Toronto Railway now has the right of way, and the work of grading will be begun very soon. The new line will pass through Jordan, Beemsville, Wiona and several other small places.

ELECTRIC LIGHTING

TUPPER LAKE, N. Y.—A canvass is being made for prospective customers, and if sufficient encouragement is given an electric light plant will be established at Tupper Lake.

MEMPHIS, TENN.—Conditional sale of a majority of the stock of the Memphis Light and Power Company, capitalized at $500,000, has been made, the purchasers being Anthony N. Brady, of New York, and C. K. G. Billings, of Chicago.

ANDERSON, IND.—Arrangements have been completed by the officials of Pendleton's town corporation to put in an electric light plant at that place as soon as possible. The power-house is to be erected on ground secured from the Aimen estate in the eastern part of the town.

MILWAUKEE, WIS.—The Milwaukee Electric Railway and Light Company is rebuilding the old Badger electric plant at a cost of $400,000 to provide power and electric light. The power to be generated there will be supplied principally to the south side lines of the company.

FREDERICK, MD.—The municipal lighting plant at Frederick, Md., will be enlarged, and a contract has been let for new boilers and also for two new 65-light dynamos. A new plant of greater capacity than the original is contemplated, and it is purposed to use the old plant as a reserve.

VICENNES, IND.—The city council has passed over the Mayor's veto an electric light ordinance granting to Joseph L. Bayard and others a thirty-year franchise to operate light, heat and power systems in the city and giving them the right to consolidate with any concern that may put in a plant.

FORT COLLINS, COL.—The plant and franchise of the Fort Collins Electric Company have been sold to Colorado Springs parties. The new owners are Bonbright & Company, C. H. White and Charles Page. The city has given the new company a ten-year contract for street lighting and the company has agreed to remodel the plant in every particular.

SALEM, ORE.—The city council has taken preliminary steps toward the possible construction, at some future time, of its own electric light plant and appropriation of funds has been made to enable a special committee of the council to investigate an available water power within a radius of forty miles of Salem with a view of purchasing the most desirable.

COLUMBUS, OHIO—Director Immel, of the Department of Public Improvement, has announced that he would proceed at once with the extension of the municipal electric lighting plant to a capacity sufficient to illuminate all the streets of the city. This action is taken in anticipation of the immediate issuance of $175,000 bonds recently sanctioned by the citizens.

NEVADA CITY, CAL.—The Central California Electric Company has petitioned the board of supervisors for a franchise to construct a pole wire in all the towns and villages in the county for a term of fifty years. The company is practically the same as the South Yuba Water Company. It proposes to erect an electric plant at Alta, Placa County, to distribute power and light to Grass Valley, Nevada City and other places.

NEW YORK, N. Y.—The officers of the Queens Borough Electric Light and Power Company have notified the stockholders in a circular note of a proposition for the purchase of the stock. The offer was to purchase all, but not less than a majority, of the stock for cash at the rate of $125 per share for the common, and $150 per share for the preferred. The name of the proposed purchaser has not been disclosed, but it is said that the New York & Queens Electric Light and Power Company is specially interested.

RICHMOND, IND.—The Varney Construction Company, the Indianapolis contractors of the Richmond municipal light plant, has received in the neighborhood of $100,000 in partial payments. The contract price is $144,000 and the balance of the money is being withheld by the city until such time as the plant shall have been turned over by the contractors. Under the provisions of the contract the plant must be first subjected to a thirty days' test and every effort was made to get the machinery started by April 1.

NEW INCORPORATIONS

INDIANAPOLIS, IND.—The Parker Telephone Company, of Parker, notified the Secretary of State of an increase in its capital stock from $2,500 to $10,000.

ALBANY, N. Y.—Hunt & Etrick Telephone Company, of West Chenango, Broome County. Capital, $1,200. Directors: W. A. Johnson, Frank Brigham and E. B. Green, of West Chenango.

MADISON, WIS.—State Telephone Clearing Company, Weyauwega; to act as a clearing company for toll business of telephone companies. Capital stock, $5,000. Incorporators: A. L. Hutchinson, Ned W. Lowe, H. E. Kepler.

GUTHRIE, OKLA.—The Metropolitan Construction Company, of Oklahoma City, for a term of twenty years; to construct street railways, gas plants, etc. $25,000. Incorporators: James R. Keaton, Frank Wells and Marian L. Spitler.

JERSEY CITY, N. J.—Municipal Electro-Chemical Company, No. 185 Montgomery street, Jersey City, N. J.; capital, $100,000; incorporators: Osborn Congelton, Henry F. West and George H. Cook. Del Rio Water Power Company, Union Hill, N. J.; capital, $75,000; incorporators: George R. Allison, H. G. C. Thornton and John W. Avery.

MADISON, WIS.—The Fox River Valley Gas and Electric Company, of Appleton; increasing from $350,000 to $400,000. Interstate Telephone Company, of La Crosse; amendment increasing capital stock from $100,000 to $150,000. Orfordville Telephone Company, of Orfordville; capital, $10,000; incorporators: H. C. Taylor, O. P. Gaarder, G. Clementson, J. W. Kirthley, J. A. Lorgh, T. E. Tollefsrud.

ELECTRICAL SECURITIES

Many developments and happenings of importance marked another eventful week in security markets. In Wall street the transactions for the six days showed an average of over 1,150,000 shares. Agricultural conditions which in the opening of the week were not very satisfactory have materially improved, and it is believed that the reports of recent damage will upon a further investigation be found to have been exaggerated.

A steady increase in interest and activity on the part of customers has been reported by the commission houses, although considerable of this business was driven away by the heavy trading and consequent slump in the early part of the week.

A steady improvement in the monetary situation with call rates as low as 3½ per cent, has been a favorable and important development of the week. The banks have been gaining in cash from the Sub-Treasury and the Interior and the outlook is for continued monetary ease until the annual outflow of currency for crop holding purposes starts in late in July.

The consummation of the long-rumored steamship combine, which is expected to have a great influence in giving this country financial and commercial supremacy, was a very important incident in the week's happenings. The allied lines are to be joined by a security holding company along the lines of the United States Steel Corporation. It is said that the capital stock will be $120,000,000 divided equally into common and preferred, with $50,000,000 of debenture bonds. The decision early in the week of the United States Supreme Court to entertain the action of the State of Washington against the Northern Securities Company is believed to have no bearing upon the final outcome of the case, being generally regarded, however, as a favorable occurrence as it would permit of a final decision by the nation's court of last resort in a much shorter time than if the administration's pending case was taken through the lower courts.

ELECTRICAL SECURITIES FOR WEEK ENDING APRIL 26.

New York:	Closing.
Brooklyn R. T.	70¼
Con. Gas	227
Gen. Elec	328
Kings Co. Elec	200
Man. El	135¼
Met. St. Ry	152¼
N. Y. & N. J. Tel. Co	172½
Westinghouse Mfg. Co	230

The adjourned meeting of the Metropolitan Street Railway stockholders has been again adjourned until Saturday, May 24, at 11 A. M.

A quarterly dividend of 1¾ per cent upon the assenting stock of the Westinghouse Electric and Manufacturing Company has been declared payable May 15 to stockholders of record at the close of business on April 30.

The annual report of the General Electric Company shows profits for the year ending January 31, 1902, including almost $1,000,000 derived from the sale of securities, of $8,598,241, of which $1,997,966 was paid in dividends and interest. The stocks and bonds owned by the company increased in value over $2,000,000 during the year so that there was carried to surplus account $8,657,960.

The Brooklyn Rapid Transit's March gross increase amounted to $72,000. The increase for April has so far been about at the rate of $2,000 per day. The gross earnings for the fiscal year ending June 30 are estimated to be about $12,000,000, or about $600,000 over last year. Stock of the Brooklyn Rapid Transit early in the week closed at 67⅞. On the last day of business it closed at 70¼. In connection with the upward movement there were heard again the rumors of the great Pennsylvania-Long Island-Brooklyn Rapid Transit-New York, New Haven & Hartford alliance. These rumors have been denied at the offices of each of the companies.

Boston:	Closing.
Am. Telep. & Tel	181
Edison Elec	275
Mass. Elec. pf	97⅛
New England Tel	148½
Western Telephone & Telegraph	105½

American Telephone had a very good week and closed several points higher. The May investment demand is given as the reason for the advance in this specialty and Edison Electric which sold up to 275.

Philadelphia:	Closing.
Elec. Co. of America	7½
Elec. Stor. Bat. c	80
Elec. Stor. Bat. pf	83¼
Philadelphia Elec	5⅝
Union Traction	43⅜
United G. I. Co	122

There was quite a demand for Electric Storage Battery early in the week, but later in closing, on a few small sales, there was a drop of some two points. United Gas Improvement was strong on rumors that negotiations were on foot looking to the acquisition of the Providence electric lighting plant and several electric railway lines in Rhode Island.

Chicago:	Closing.
Chicago Edison Light	175
Chicago Telep	175
Metropolitan El. pf	90½
National Carbon	25
National Carbon pf	90
Union Traction	21
Union Traction pf	57

Trading in local stocks was moderately active, there being a considerable demand for Carbon common at 25 and Union Traction at 21¼. A call will be issued for a meeting of the Union Traction directors for about May 15. If it is possible to secure a quorum some new directors will probably be elected at this time. Directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable May 15.

OBITUARY NOTICE

MR. CHARLES H. PORTER, late with the New York & New Jersey Telephone Company, died at his residence 1329 Pacific street, Brooklyn, N. Y., Sunday, April 27, of heart failure. Mr. Porter had been connected with the District Telegraph and Telephone companies in New York for the past twenty-five years, and had a wide circle of friends and acquaintances.

PERSONAL MENTION

MR. WILLIAM STANLEY returned last week from an extended trip abroad, during which he visited important points in France, Italy, Austria and England.

MR. WARD S. ARNOLD, with the General Electric Company's Chicago office, has accepted the position of sales engineer to the Chicago office of the Stanley Electric Manufacturing Company.

MR. GEORGE A. MCKINLOCK, of Chicago, president of the Central Electric Company, was a New York visitor this week. Mr. McKinlock is enjoying a few days' rest in the East at the Hotel Brighton, Atlantic City.

LORD KELVIN was an interested visitor at the power developments at Niagara Falls early in the week. Commenting upon the high temperatures employed and the process of converting amorphous carbon into valuable graphite, he is reported as saying: "It ought to be easy to manufacture the diamond."

MR. CYRUS O. BAKER, JR., of the platinum refining house of Baker & Company, sailed for Europe this week and will be absent about sixty days. Mr. Baker, who is master of transportation for the National Electric Light Association, has made all arrangements for transportation for the convention which is to be held at Cincinnati, May 20, 21 and 22, and correspondence respecting it should be addressed to the secretary of the association, Mr. George F. Porter, 136 Liberty street, New York city. Mr. Baker had planned to postpone his European trip until later, but urgent business in London requires his attention during the month of May.

AUTOMOBILE NOTES

MILE RECORD TEST—The Automobile Club of America has secured the necessary permission from the board of aldermen to hold a mile record contest May 31, 1902, on the South Shore Boulevard, Staten Island. This will be open to motor vehicles of all classes. Gold and silver medals will be awarded respectively to vehicles making the best and second best time in each class. Conditions and further particulars will be announced later.

AUTOMOBILES IN THE HOLY LAND—Enquiries about automobiles are being made in Syria. Only one specimen—an inferior second-hand machine—has been seen there, and it is thought that in Syria and Palestine automobiles would be greatly favored, as there is a great lack of railroads and street cars and the carriage road system is rapidly developing. A new road is now being built between Sidon and Beirut. The vehicles to be used on these roads must be strong and durable, as parts of the region are steep and there are numerous sharp turns. Between Haifa and Nazareth the most satisfactory carriages employed in the tourist traffic are powerful two-seated surreys made in Buffalo, N. Y. The horses suffer greatly from the heat in these parts, and in this direction the automobile would be immediately at an advantage. In Beirut 500 carriages are running and hundreds more are in use in Lebanon and Palestine.

INDUSTRIAL ITEMS

MR. H. C. SPAULDING is now associated with Sargent, Conant & Company, electrical engineers, Boston, Mass.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., presented its friends with a neat blotter-calendar for April.

THE AMERICAN STOKER COMPANY has removed its offices to the Broadway Chambers Building, 277 Broadway, New York city.

THE NEW YORK INSULATED WIRE COMPANY has moved its New York city offices to the Engineering Building, 114 to 118 Liberty street.

THE ECONOMY ELECTRIC COMPANY, Warren, Ohio, has begun the erection of an addition to its plant. This company refills incandescent lamps which have been exhausted.

FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., illustrates in two handsome bulletins, Nos. 1020 and 1021 respectively, the "Wood" systems of generators and motors, which are manufactured by this company.

THE HAINES & NOYES COMPANY, Chicago, Ill., through its private telephone plant department, has closed a number of contracts throughout the country for apartment-house and intercommunicating telephone systems.

THE BRYAN-MARSH COMPANY is removing its New York offices to the ground floor of 136 Liberty street. It will greatly increase its office space and facilities, and in its new quarters will be most accessibly located on a prominent thoroughfare.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is sending to the trade this week new catalogues of the Packard incandescent lamps and also a catalogue of full line of Whitney instruments. The company will be glad to mail these on request.

THE NATIONAL ELECTRIC IMPROVEMENT COMPANY, New York city, manufacturer of the "Elbright" system of wiring for incandescent lamp display, is preparing a magnificent catalogue of half-tones, illustrating many fine installations with this system.

THE LE VALLEY VITAE CARBON BRUSH COMPANY, New York, will remove on May 1 to 119-125 East Forty-second street. A large stock, including all sizes of this company's carbon brushes, will be carried at these offices and salesrooms, and facilities will be had for giving immediate shipments.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., general sales agent for the Peerless direct-current fans and Emerson alternating-current fans, reports the outlook for business in fans extremely satisfactory. A large number of contracts for both types of fans have already been secured.

THE ACME PAY STATION COMPANY, of Ludington, Mich., has recently succeeded the Mason Telephone Pay Station Company of that city, and is entirely revising the field of the Mason company in constructing absolutely new types and styles of pay stations, telephone booths and other telephone appurtenances.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, is soon to remove into a large and newly constructed factory building erected solely for its occupancy. The company will have greatly increased manufacturing and stock facilities, and also most comfortable and elaborate quarters for its suite of business offices.

THE OHIO BRASS COMPANY, Mansfield, Ohio, will send to those who are interested its Bulletin No. 9, describing in detail the development and application of the "All Wire" rail bond manufactured by this company. Mr. Alfred B. Edes is the manager of the New York city office, 1702 Commercial Cable Building.

THE STERLING VARNISH COMPANY, Pittsburg, Pa., has published a very handy little pocket memorandum which goes thoroughly into the specifications for testing insulating varnishes. This is a very desirable little book and the company will be pleased to furnish it, free, to those who are interested enough to make a request for it.

THE AMERICAN INSULATED WIRE AND CABLE COMPANY, Chicago, Ill., manufacturer of water-proof, office and annunciator wire, has excellent facilities both as regards office conditions and factory requirements, to meet the market for this material. The present capacity is over 350,000 pounds per month and a ready demand is steadily in evidence.

THE WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, Ohio, is distributing to some of its favored friends a striking picture of a caged tiger, the tiger in the picture being behind real bars. The restless energy represented by the tiger in captivity is suggested by the company as the characteristics of its own management.

BELL TELEPHONE MANUFACTURING COMPANY, Baraboo, Wis., is organized for the purpose of redesigning old styles of telephone instruments and switchboards, so as to make antiquated apparatus modern and up to date. This company has a complete line of new and second-hand telephone apparatus on hand upon which it is glad to quote prices.

THE AMERICAN CARBON AND BATTERY COMPANY, St. Louis, Mo., successor to the Booker Carbon and Battery Company, is offering a recently perfected cell known as the "Phœnix No. 1" for use in connection with telephone, gas engine and heavy open-circuit work. This company manufactures battery carbon and carbon specialties for telephone and experimental work.

THE UNION ELECTRIC CONSTRUCTION COMPANY, Philadelphia, Pa., is about to have a complete reorganization. Mr. M. Nelson Faulk has been made general manager of the company, and at the regular meeting in June a new board of directors is planned as follows: Charles Barth, John L. Hawthorne, William Boekel, P. C. Oberdorff, H. J. Tibbals and A. R. Saylor.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is sending to its friends a neat little pamphlet entitled "A Short Heart to Heart Talk, Full of Reasons Why." This dainty little book contains a number of half-tone illustrations of Emerson fans of different types, together with several pages of text of the character which is designated by its title.

THE DRIVER-HARRIS WIRE COMPANY, Newark, N. J., has moved to its new factory building on Railroad avenue, Harrison, N. J., where its facilities will be very much increased. The large demand for its material has made this necessary and the company contemplates still greater increases and will probably take up the manufacture of steel wire in the near future.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has published a 1902 edition of its fan motor catalogue. This contains a complete line of desk, bracket and ceiling fans for all currents and voltages and includes power motors, sewing-machine motors, battery fans and ventilating fans, etc. Any one desiring a copy of this catalogue can procure one by addressing a request to the company.

THE DALE COMPANY, New York city, has taken up the manufacture of electrical appliances in connection with other specialties, and expects to put out a number of new things in this line, already having put on the market a new flush receptacle which has the advantages of having no screws through the face-plate and a flush porcelain plug which is made with or without fuse. A chemical polarity indicator, a bug cut-out, and a current tap are now ready. A new push-button flush switch will be ready in a few weeks.

DOUBLEDAY, PAGE & COMPANY, New York city, are the publishers of Andrew Carnegie's new book, "The Empire of Business." This volume contains the results of Mr. Carnegie's long business career and the author has covered fully the important points in business conduct and management, beginning with a young man's first start, discussing the A-B-C of money, capital and labor, the winning of a fortune and its spending, etc. The indications are that 50,000 copies of this book will be sold within a short time.

THE GOULD STORAGE BATTERY COMPANY, New York city, has secured, among recent contracts, an order for a battery of 245 cells for the Uniontown station of the Pittsburg, McKeesport & Connellsville Railway Company, Pittsburg, Pa. This installation has a capacity of 171 kilowatts and will be used as a floating battery on the present direct-current equipment, ultimately being increased by the addition of sixty cells with a plate capacity of 212 kilowatts and a tank capacity of 318 kilowatts, when it will be used in connection with the rotary transformer station.

R. B. CORBETT, New York city, announces that he has secured the good will, stock and appurtenances of the domestic machinery department of Frank Brothers, and has consolidated the same with the A. G. Schoonmaker Company, of 126 Liberty street, New York city, with whom he intends to carry out contemplated extensions and improvements of Frank Brothers, including a factory and yards at Newark, N. J. The new concern will carry a full line of first-class new and second-hand electrical machinery, and also repair broken or cracked cylinders of all automatic, Corliss and high-speed engines and pumps by a new secret process of burning on.